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Boston Society of Natural History

March 23, 1945



TRANSACTIONS
OF THE
WATFORD NATURAL HISTORY SOCIETY.

VOLUME II.

TRANSACTIONS

OF THE

WATFORD

NATURAL HISTORY SOCIETY

AND

HERTFORDSHIRE FIELD CLUB.

EDITED BY JOHN HOPKINSON, F.L.S., F.G.S.

VOLUME II.

OCTOBER, 1877, TO JULY, 1879.

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Dates of publication of the several parts contained in this volume :

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„ 3.	„ 89-112, and xvii-xxiv	March, 1879.
„ 4.	„ 113-156, and xxv-xxxii	June, 1879.
„ 5.	„ 157-196, and xxxiii-xl	Sept. 1879.
„ 6.	„ 197-236, and xli-xlvi	Dec. 1879.
„ 7.	„ 237-252, and xlix-lx	April, 1880.
„ 8.	„ 253-260, and i-viii	June, 1880.

PROCEEDINGS

OF THE

WATFORD NATURAL HISTORY SOCIETY.

ORDINARY MEETING, 18TH OCTOBER, 1877.

ALFRED T. BRETT, Esq., M.D., President, in the Chair.

The President, on taking the Chair, stated that the meeting had been deferred from the second Thursday in the month, the 11th inst., owing to the Rev. Dr. Gee, who had consented to give the opening lecture of the session, having had an engagement on that evening.

Mr. Henry Adcock, Queen's Road, Watford; Mr. Oscar Clayton, Grove Cottage, Heathbourne, Bushey Heath; Mr. William Ransom, Fairfield, Hitchin; Mr. George Stone, Cassio Bridge, Watford; and Mr. George Turnbull, F.R.A.S., F.R.G.S., M.I.C.E., Rose Hill, Abbots Langley, were elected Members of the Society.

The following lecture was delivered:—

“Famous Trees in Hertfordshire.” By the Rev. Canon Gee, D.D. (*Vide* page 1.)

Mr. Matthew Moggridge said that he had always taken a great interest in trees, had long practised both modes of measuring their height now laid before them, and could vouch for the accuracy and ease with which they could be carried out without any abstruse calculations. The case of beheading trees that had been alluded to recalled to his mind those beautiful oaks in Richmond Park (Surrey). They were beheaded by order of George the Third, early in his reign, to give them eventually a more picturesque appearance. They were beautiful trees certainly, but the few which had escaped beheading were, to his mind, much more beautiful, and for this amongst other reasons, that they were more true to nature.

The President said that he had requested Mr. Heather to measure the lime tree at Cassiobury which Lord Essex had told him was the first lime tree planted in this part of the country; and he had found the circumference, at three feet above the ground, to be 17 feet 10 inches, and the height about 100 feet. He suggested that the word “wych” in wych-elm might have been the name for a coffin, as elm was used for making coffins, and he inquired as to the position of the King and Queen beeches at Ashridge.

Dr. Gee said that the beeches at Ashridge were on the right front of the house. They might easily be identified, as they had a number of names cut on them. With regard to “wych” being a box for the dead, he could only say that in the oldest quotation in which the word was mentioned it was as a box for cheese.

The President then, on behalf of himself and other members of the Society, presented to the Honorary Secretary an elegant drawing-room clock and side ornaments. In the course of a complimentary speech he said that most of the members present knew that Mr. John Hopkinson might be regarded as the founder of the Society, and that as he had now secured for himself a help-mate—a lady who had distinguished herself in the field of botany—it was thought a very suitable time to give him some token of their regard and esteem. The subscribers were much indebted to Mr. J. E. Littleboy, who had kindly acted as secretary and treasurer.

Mr. Hopkinson briefly thanked the subscribers for their very handsome present, and Dr. Brett for the kind way in which he had alluded to his labours for the Society.

ORDINARY MEETING, 8TH NOVEMBER, 1877.

ALFRED T. BRETT, Esq., M.D., President, in the Chair.

The following communications were read:—

1. "The Birds of Our District." By John E. Littleboy. (*Vide* p. 17.)

2. A letter from Mr. George Rooper, F.Z.S., to the President, dated 29th October, 1877, on Birds observed near Watford.

Mr. Rooper stated that he had seen no really rare birds in this neighbourhood. The game keepers, and more wickedly foolish still, the gardeners, destroyed them. Of the less common birds he had a pair of hawfinches (*Coccothraustes vulgaris*) for a long time in his garden. They haunted an old quince tree, but it was cut down, and they disappeared. A pair of nuthatches (*Sitta cæsia*) might frequently be seen running up and down the trunk of a cedar before his dining-room windows. These birds built in the cavity of a tree, and if, as generally happened, the hole was too large for their approval, they plastered it up in the most artistic manner. He had often seen the red-backed shrike (*Lanius collurio*) about Oxhey Wood, and once when hunting he had seen a pair of buzzards (*Buteo vulgaris*) in a wood near Stevenage. Their congener the kite (*Milvus icinus*) was nearly extinct. The last he had seen was about fifteen years since, near Hertford. A merganser (*Mergus serrator*) was shot at Otterspool some years ago and sent to him. He was absent and his cook dressed it! Green woodpeckers (*Geococcyx viridis*) were occasionally seen in Cassiobury, but not being "game birds" Forsdyke the keeper shot them. He thought that the bustard (*Otis tarda*) had been practically long extinct. A solitary male specimen appeared last year on Mr. Appleby's estate in Norfolk. He went to great expense in procuring "a help meet for him," and the pair were shot in the course of a week and set up by the talented taxidermist of the neighbourhood!

3. "Notes on Birds observed near Hitchin." By James H. Tuke. (*Vide* p. 33.)

Mr. John Evans, F.R.S., said that he could add one or two birds to Mr. Littleboy's list, which were shot, unfortunately, in his own neighbourhood. One was the bittern (*Botaurus stellaris*) which he remembered being shot, 30 years ago, at Boxmoor. In his own garden a godwit (*Limosa lapponica*) was found, which unfortunately died. He also remembered a quail (*Coturnix communis*) being shot in his neighbourhood. There were a few matters he might mention in illustration of the habits of birds. He was not quite certain whether it had been noticed in this neighbourhood that crocuses were cut off in the early spring.

Some years ago a certain number of London sparrows made the discovery—to them perfectly new—that at the base of the crocus there is a small globule of honey. They cut off all the flowers they came across; and the sparrows as far down in the country as this had now found it out. It was a very curious instance of the way in which birds had the power of imparting knowledge to other birds. With regard to the removal of eggs by the partridge, he could not help thinking that they must have been removed by some other two-legged animal. We had in this district two varieties of the partridge—the French and the English—and he was inclined to think that the French variety was gaining ground, there being a larger number now to be found than formerly. He thought that the idea of Dr. Johnson, as to swallows “conglobulating” together, was derived by him from books rather than from nature,—there was some mention in history of swallows descending to the bottom of Lough Neagh, in Ireland, and being dragged up by fishermen in their nets. There was one very curious feature with regard to starlings, namely that, although not migratory birds, they had a way of assembling in the autumn in the same manner as migratory birds; and it had been suggested that it was probably the remnant of habits they had when the climate was more severe than at present, and they had to migrate, as they were not under the necessity of doing now. That brought their minds to one of the geological features in connexion with this paper, and he thought they would all acknowledge the truth of the concluding remarks relative to the view we take of creative power.

Numerous stuffed specimens of birds, chiefly the rarer birds which had been found in Hertfordshire, were exhibited by Mr. Barraud, Mr. C. E. Fry, Mr. Littleboy, Mr. George Willshin, and the President.

ORDINARY MEETING, 13TH DECEMBER, 1877.

ALFRED T. BRETT, Esq., M.D., President, in the Chair.

The Right Honourable the Earl of Clarendon, the Grove, Watford, was elected a Member of the Society.

The following communications were read:—

1. “Further Notes on our Birds.” By J. E. Littleboy. (*Vide* p. 35.)

The President said that after the remarks of Mr. Evans, at the previous meeting of the Society, as to the possibility of partridges carrying their eggs, his daughters reminded him that some doves they had kept carried their eggs about with their feet; so that it was very probable that partridges carried their eggs in a similar manner. The Council had decided that a register of birds frequenting the county should be kept, and as Mr. Littleboy had undertaken to be registrar, he would ask him to describe the method that would be pursued.

Mr. Littleboy said that in preparing his paper it had occurred to him that it would be desirable to have a systematic record of the birds known to visit the county. The only way in which this could be satisfactorily accomplished was by one of the members of the Society acting as registrar and correspondent. The Council had requested him to act as registrar, and he should be pleased to receive from the members, or from any one else, particulars of the visits of the more common as well as of the rarer birds.

2. “Report on Phenological Phenomena in Hertfordshire in 1876.” By John Hopkinson, F.L.S., etc., Hon. Sec. (*Vide* p. 37.)

Mr. Littleboy said that the question of the time of flowering of plants was of a very similar character to that of the periodical visits of birds. It became really a portion of the history of the year; and as year after year went by, the character of the seasons was to some extent ascertained by the time of flowering of plants, appearance of insects, and visits of birds. He should like to know

how the word "early" was applied to the singing of the thrush on the 25th of December. He had noticed the extraordinary manner in which the thrush was singing at the present time, and had never noticed such a thing before.

Mr. Hopkinson explained that if certain plants, such as the snowdrop, which usually flowered in January, came out before January, he should consider that they flowered unusually early; and so in the case of the birds, the thrush usually began to sing early in January, but in the winter of 1875-6 it was first heard near the end of December. He had entered it in the 1876 report, considering it to be an unusually early phenomenon pertaining to that report, though in this instance occurring a week before the end of 1875.

DONATIONS TO THE LIBRARY IN 1877.

TITLE.	DONOR.
ATTFIELD, PROF. JOHN. Chemistry: General, Medical, and Pharmaceutical. 6th edition. 8vo. London, 1875	<i>The Author.</i>
CAPEL, C. C. Trout Culture. 8vo. London, 1877	<i>Dr. A. T. Brett.</i>
GANNETT, HENRY. List of Elevations West of the Mississippi River. (<i>U.S. Geol. Surv.</i>) 8vo. Washington, 1877	<i>Prof. F. V. Hayden.</i>
GEOGRAPHICAL MAGAZINE. Vol. iv. 4to. London, 1877	<i>Lieut. R. B. Croft.</i>
HENSLOW, REV. J. S. Descriptive and Physiological Botany. 8vo. London, 1839	<i>Mr. J. Hopkinson.</i>
HITCHCOCK, PROF. E. The Religion of Geology and its connected Sciences. 8vo. London, 1851	"
HUDLESTON, W. H., and J. F. WALKER. On the Distribution of the Brachiopoda in the Oolitic Strata of Yorkshire. (<i>Proc. Yorkshire Philos. Soc.</i> 1877)	<i>The Authors.</i>
JACKSON, W. H. Descriptive Catalogue of the Photographs of the United States Geological Survey of the Territories for the years 1869 to 1875. 2nd edition. (<i>U. S. Geol. Surv.</i>) 8vo. Washington, 1877	<i>Prof. F. V. Hayden.</i>
JEFFREYS, DR. J. GWYN, and DR. W. B. CARPENTER. The Valorous Expedition. 8vo. London, 1876	<i>Dr. Gwyn Jeffreys.</i>
LESQUEREUX, LEO. Supplement to Fifth Annual Report of the U. S. Geological and Geographical Survey of the Territories. Report on Fossil Flora. (<i>U.S. Geol. Surv.</i>) 8vo. Washington, 1877	<i>Prof. F. V. Hayden.</i>
LYELL, SIR CHARLES. The Principles of Geology. 9th Edition. 8vo. London, 1853.	<i>Mr. J. Hopkinson.</i>
MARRIOTT, W. Table for facilitating the determination of the Dew-point from Observations of the Dry- and Wet-bulb Thermometers. London, 1874	<i>The Author.</i>
———. Remarks on the Reduction of Barometric Readings, with a form of Table for combining the Corrections for Index Error, Temperature, and Altitude. (<i>Quart. Journ. Meteorological Soc.</i> 1876).	"
METEOROLOGICAL SOCIETY. Report of the Council for 1861. 8vo. London, 1862.	<i>Dr. A. T. Brett.</i>
MICROSCOPICAL, MONTHLY, JOURNAL. Vols. xv-xvi. 8vo. London, 1876	<i>Lieut. R. B. Croft.</i>
MORRIS, PROF. J. The Geology of Croydon. 8vo. Croydon, 1877	<i>The Author.</i>
NATURALIST. Vols. i-iii. 8vo. London and Huddersfield, 1865-67.	<i>Mr. J. Hopkinson.</i>

TITLE.	DONOR.
SCOTT, R. H. Instructions in the use of Meteorological Instruments. 8vo. London, 1875. . . .	<i>Mr. J. Hopkinson.</i>
SCIENCE GOSSIP, 1877. 8vo. London, 1877 . . .	<i>The Publishers.</i>
SYMONS, G. J. Reports of the Rainfall Committee of the British Association, for 1865, and 1870-75. 8vo. London, 1863-76. . . .	<i>The Author.</i>
———. Monthly Meteorological Magazine. Vol. xii. 8vo. London, 1877	<i>The Editor.</i>
SYMONS, G. J., C. Greaves, and J. Evans. Rainfall and Evaporation. (<i>Proc. Inst. Civil Engineers</i> , 1876) .	<i>Mr. John Evans.</i>
UNITED STATES GEOLOGICAL AND GEOGRAPHICAL SURVEY OF THE TERRITORIES. Bulletin. Vol. ii, Nos. 2-6. Vol. iii, Nos. 1-3. 8vo. Washington, 1876-77	<i>Prof. F. V. Hayden.</i>
———. The Grotto Geyser of the Yellowstone National Park. Folio. Washington, 1877 . . .	„
WARWICKSHIRE NATURAL HISTORY AND ARCHEOLOGICAL SOCIETY. Annual Reports for 1863 and 1868-73. 8vo. Warwick, 1864-74	<i>Mr. J. Hopkinson.</i>
WARWICKSHIRE NATURALISTS' AND ARCHEOLOGISTS' FIELD CLUB. Proceedings for 1867, 1868, and 1871-73. 8vo. Warwick, 1868-74	„
YARRELL, W. A History of British Birds. 4th edition. Revised by Alfred Newton. Parts 1-6. 8vo. London, 1871-3	<i>Mr. A. T. Barraud.</i>

PUBLICATIONS OF SOCIETIES RECEIVED IN EXCHANGE.

- BATH NATURAL HISTORY AND ANTIQUARIAN FIELD CLUB. Proceedings. Vol. iii, No. 4. 8vo. Bath, 1877.
- BEDFORDSHIRE NATURAL HISTORY SOCIETY AND FIELD CLUB. Transactions for 1875-76. 8vo. Bedford, 1877.
- BELFAST NATURAL HISTORY AND PHILOSOPHICAL SOCIETY. Proceedings for 1875-76. 8vo. Belfast, 1877.
- BRIGHTON AND SUSSEX NATURAL HISTORY SOCIETY. Proceedings for 1875-76. 8vo. Brighton, 1877.
- BOSTON (U.S.) SOCIETY OF NATURAL HISTORY. Proceedings. Vol. xvii, Parts 1, 2. Vol. xviii, Parts 3, 4. 8vo. Boston, 1875-77.
- CHESTER SOCIETY OF NATURAL SCIENCE. Annual Report for 1876-77. 8vo. Chester, 1877.
- CROYDON MICROSCOPICAL CLUB. Reports for 1870 and 1872-75. 8vo. Croydon, 1871-77.
- . THE ANTIQUITY OF MAN. By Prof. T. Rupert Jones. 8vo. Croydon, 1877.
- EASTBOURNE NATURAL HISTORY SOCIETY. Papers. Session 1876-77. 4to. Eastbourne, 1877.
- EDINBURGH BOTANICAL SOCIETY. Transactions and Proceedings. Vol. xii, Parts 1, 2. 8vo. Edinburgh, 1874-75.
- EDINBURGH GEOLOGICAL SOCIETY. Transactions. Vol. iii, Part 1. 8vo. Edinburgh, 1877.
- EDINBURGH. ROYAL PHYSICAL SOCIETY. Proceedings. Session 1874-75. 8vo. Edinburgh, 1876.
- ENTOMOLOGICAL SOCIETY. Proceedings. 1871-76. 8vo. London, 1872-77.
- . Catalogue of British Neuroptera. By R. McLachlan. 8vo. London, 1870.

- ENTOMOLOGICAL SOCIETY. Catalogue of British Hymenoptera. Aculeata. By F. Smith. *ib.* 1871.
- . Chrysididæ, Ichneumonidæ, Braconidæ, and Evanidæ. By the Rev. T. A. Marshall. *ib.* 1872.
- . Oxyura. By the Rev. T. A. Marshall. *ib.* 1873.
- . Catalogue of British Hemiptera. Heteropoda and Homoptera—Cicadaria and Phylthires. By J. W. Douglas and John Scott. *ib.* 1876.
- GEOLOGICAL SOCIETY. Abstracts of the Proceedings. Session 1876–77. 8vo. London, 1877.
- GEOLOGISTS' ASSOCIATION. Proceedings. Vol. iv, No. 9. Vol. v, Nos. 1, 2. 8vo. London, 1876.
- . Annual Report for 1876. 8vo. *ib.* 1877.
- GLASGOW NATURAL HISTORY SOCIETY. Proceedings. Vol. iii, Part 1. 8vo. Glasgow, 1876.
- GLASGOW PHILOSOPHICAL SOCIETY OF. Proceedings. Vol. x, No. 2. 8vo. Glasgow, 1877.
- GLASGOW SOCIETY OF FIELD NATURALISTS. Transactions. Part 5. 8vo. Glasgow, 1877.
- LEEDS NATURALISTS' CLUB AND SCIENTIFIC ASSOCIATION. Annual Report for 1876–77. 8vo. Leeds, 1877.
- LIVERPOOL GEOLOGICAL SOCIETY. Proceedings. Vol. iii, Part 2. 8vo. Liverpool, 1877.
- MANCHESTER FIELD-NATURALISTS' AND ARCHÆOLOGISTS' SOCIETY. Proceedings for 1876. 8vo. Manchester, 1877.
- MANCHESTER GEOLOGICAL SOCIETY. Transactions. Vol. xiv, Parts 6–14. 8vo. Manchester, 1877.
- MARLBOROUGH COLLEGE NATURAL HISTORY SOCIETY. Report for the half-year ending Christmas, 1876; and Midsummer, 1877. 8vo. Marlborough, 1877.
- METEOROLOGICAL SOCIETY. Quarterly Journal. New Series. Vol. iii, Nos. 20–23. 8vo. London, 1876–77.
- NORFOLK AND NORWICH NATURALISTS' SOCIETY. Transactions. Vol. ii, Part 3. 8vo. Norwich, 1877.
- QUEKETT MICROSCOPICAL CLUB. Journal. Vol. iv, Nos. 33–34. 8vo. London, 1877.
- RUGBY SCHOOL NATURAL HISTORY SOCIETY. Report for 1876. 8vo. Rugby, 1877.
- SMITHSONIAN INSTITUTION. Annual Reports for 1875 and 1876. 8vo. Washington (U.S.), 1876–77.
- SOMERSETSHIRE NATURAL HISTORY AND ARCHÆOLOGICAL SOCIETY. Proceedings. New Series. Vol. ii. 8vo. Taunton, 1877.
- WARWICKSHIRE NATURAL HISTORY AND ARCHÆOLOGICAL SOCIETY. Annual Report for 1876. 8vo. Warwick, 1877.
- WEST LONDON SCIENTIFIC ASSOCIATION AND FIELD CLUB. Proceedings. Vol. i, Part 4. 8vo. London, 1877.
- . Annual Report for 1876–77. 8vo. *ib.* 1877.
- WILTSHIRE ARCHÆOLOGICAL AND NATURAL HISTORY SOCIETY. Magazine. Vol. xvi, No. 48. Vol. xvii, Nos. 49–50. 8vo. Devizes, 1876–77.

ORDINARY MEETING, 10TH JANUARY, 1878.

ALFRED T. BRETT, Esq., M.D., President, in the Chair.

The Rev. John Aiken Ewing, M.A., Westmill, Buntingford; Mrs. Joseph Hill, Frogmore House, Watford; and Mrs. Spedding, St. Peter's, St. Albans, were elected Members of the Society.

The following paper was read :—

“The Products of Hertfordshire.” By the Rev. James C. Clutterbuck, M.A. (*Vide* p. 41.)

A water-colour drawing of the Wymondley Chestnut, referred to in the paper, was presented to the Society by Mr. Clutterbuck.

Professor John Attfield and Mr. C. A. Booth were appointed Auditors of the Accounts for 1877.

ANNUAL MEETING, 14TH FEBRUARY, 1878.

ALFRED T. BRETT, Esq., M.D., President, in the Chair.

Mr. Allan T. Barraud, St. John's Villas, Watford; Mr. Thomas Meadows Clutterbuck, Stanmore; Mrs. R. B. Croft, Fanhams Hall, Ware; and Mr. James H. Tuke, Hitchin, were elected Members of the Society.

The Report of the Council for 1877, and the Treasurer's Account of Income and Expenditure, were read and adopted.

The President delivered an Address. (*Vide* p. 49.)

The Balloting-glass having been removed, and the lists examined by the Scrutineers, the following gentlemen were declared to have been duly elected as the Officers and Council for the ensuing year :—

President.—Alfred T. Brett, M.D.

Vice-Presidents.—Arthur Cottam, F.R.A.S.; John Evans, D.C.L., F.R.S., F.S.A., F.G.S., F.M.S.; J. Logan Lobley, F.G.S., F.R.G.S.; R. A. Pryor, B.A., F.L.S.

Treasurer.—Charles F. Humbert, F.G.S.

Honorary Secretary and Librarian.—John Hopkinson, F.L.S., F.G.S., F.R.M.S., F.M.S.

Honorary Curator.—W. Lepard Smith.

Other Members of the Council.—Prof. John Attfield, Ph.D., F.C.S.; R. Russell Carew, F.R.G.S., F.C.S.; Lieut. R. B. Croft, R.N., F.L.S., F.R.M.S.; the Right Honourable the Lord Ebury; the Right Honourable the Earl of Essex; the Rev. Canon Gee, D.D.; James U. Harford; J. E. Harting, F.L.S., F.Z.S.; J. Gwyn Jeffreys, LL.D., F.R.S., F.L.S., F.G.S.; John E. Littleboy; the Rev. C. M. Perkins, M.A.; Frank W. Silvester.

It was then resolved—

That the thanks of the Society be given to the Earl of Essex, retiring from the office of Vice-President; and to Mr. E. M. Chater, Mr. George Chippindale, and Mr. Thomas Heather, retiring from the Council.

The thanks of the Society were also accorded to the Honorary Secretary.

REPORT OF THE COUNCIL FOR 1877.

IN presenting their third Annual Report, the Council of the Watford Natural History Society and Hertfordshire Field Club have the pleasure of announcing that the Society continues to prosper, the number of its members increasing, and the papers read contributing materially to the knowledge of the Natural History of the county.

During the year 19 Ordinary Members and two Honorary Members have been elected; four members have compounded for their annual subscription; ten members have resigned; and the Council regret that they have to announce the loss of two members by death—Mr. James Cardinal Harford and Mr. Isaac Ridgway.

The census of the Society at the end of the years 1876 and 1877 was as follows:—

	1876	1877
Honorary Members	8	10
Life Members	15	19
Annual Subscribers	137	140
Total	160	169

Three parts of the Society's 'Transactions' have been printed and distributed to the members during the year, making eight parts in all; and it is intended to conclude the first volume with the ninth part, which will complete the record of the proceedings of the Society to the end of last session.

The following are the principal papers and lectures which have been read or delivered during the year 1877:—

- Jan. 11.—Fish-hatching and Fish-culture in Hertfordshire; by Alfred T. Brett, M.D. With Notes on Pisciculture by Peter Hood, M.D.
 — . Notes and Queries on the River Colne; by A. T. Brett, M.D.
- Feb. 8.—Anniversary Address; by the President, John Evans, F.R.S., F.S.A., F.G.S., F.M.S., etc.
- March 8.—The Fertilisation of Plants; by the Rev. George Henslow, M.A., F.L.S., F.G.S.
- April 12.—Instructions for taking Meteorological Observations; by William Marriott, F.M.S.
 — . Meteorological Observations taken at Holly Bank, Watford, during the year ending 28th February, 1877; by John Hopkinson, F.L.S., F.M.S., Hon. Sec.
 — . Report on the Rainfall in Hertfordshire in 1876; by the Honorary Secretary.
 — . Notes on a Remarkable Storm in Hertfordshire, April 4th, 1877; by Lieut. R. B. Croft, R.N., F.L.S.
- May 10.—On Microscopic Fungi; by E. M. Chater.
 — . Notes on some Hertfordshire Plants; by R. A. Pryor, B.A., F.L.S.
- Oct. 11.—Famous Trees in Hertfordshire; by the Rev. Canon Gee, D.D.
- Nov. 8.—The Birds of Our District; by John E. Littleboy.
 — . Notes on Birds observed near Hitchin; by J. H. Tuke.
- Dec. 13.—Further Notes on Our Birds; by J. E. Littleboy.
 — . Report on Phenological Observations in Hertfordshire in 1876; by the Honorary Secretary.

Several short communications, which appear in the 'Transactions' under the heading of "Miscellaneous Notes and Observations,"

have also been read. These treat almost entirely of the Botany and Zoology of the county, subjects to which, as will be seen from the above list, a considerable amount of attention has been paid during the year.

It may be here pointed out that, if we exclude the short notes from our consideration, in 1875—the first year of the Society's existence—geology and botany were almost the only subjects upon which papers were read; in 1876, geology and meteorology, there not being a single botanical or zoological paper; and in 1877, meteorology, botany, and zoology, no geological paper having been communicated. Taking therefore the three years together, each of the sciences for the advancement and study of which the Society was founded has received a fair amount of attention. Little has however been done with the microscope—Mr. Chater's paper on "Microscopic Fungi," and a lecture by Mr. Cottam on "Microscopical Mounting," being the only communications during the three years on any subject for the elucidation of which the microscope is necessary.

An attempt was made in the spring to hold a series of extra informal meetings for the examination of microscopic objects, but so few microscopes were brought, and the attendance of members was so small, that the experiment cannot be said to have been successful. The microscopic object cabinet, also, purchased in 1876, does not yet contain a single object. Several have been promised, and if a small collection of slides could be got together it would doubtless encourage members to add to this nucleus any duplicates they may have, and some perhaps to mount objects, or to purchase them, specially for the Society.

The meteorological and phenological reports for 1876 have been presented, and will soon be in the hands of the members. A form for entering the returns of the rainfall has been prepared, and is sent to about 25 observers in the county; and another for the registration of periodical natural phenomena is now in the press, and copies will be sent to any members who will assist in the work.

Although the year was an unusually wet one, the rainfall having exceeded that of the two previous years, in both of which it was considerably above the average, the weather only prevented one of the projected Field Meetings from being carried out. This, the last of the season, was intended to have been held at Elstree Reservoir on the 14th of July, in conjunction with the Quekett Microscopical Club. At the Field Meetings which took place the following localities were visited:—

- May 5.—Stanmore Common.
- 26.—Oxhey Woods and Pinner.
- June 16.—Hitchin.
- 30.—Cassiobury Park.

For hospitality kindly afforded at the Field Meetings the Society is indebted to five of its members—Mr. William Verini, Mr. William A. Tooke, Mr. William Ransom, Mr. Joseph Pollard, and

your President, Dr. Brett. To the Earl of Essex the Society is also indebted for his kindness in allowing the members to go over his house and grounds at the meeting in Cassiobury Park, and for his notes on the more remarkable trees which were examined on that occasion. At the Hitchin meeting, which was the first which has occupied an entire day, the kindness and hospitality of Mr. Ransom deserve special acknowledgment. He provided a sumptuous luncheon for a numerous party—the meeting being largely attended—and also carriages to convey the party to Lilley Hoo and the Chalk hills north of Hitchin.

The Council have the gratification of stating that all the Field Meetings were well attended. At each meeting a larger party assembled than at the one preceding—the meeting in Cassiobury Park, at which about 80 of the members were present, being the most numerously attended of any which have been held since the Society was founded.

The financial condition of the Society continues to be satisfactory. The expenditure during the year was about the same as in the two previous years, and there is a considerable balance in hand. In addition to this balance the sum of £22 10s. is due to the Society for arrears of subscriptions, principally for 1877, and the balance sheet shows that, although the number of members has increased since the previous year, the amount received for subscriptions is £11 less. The sum of £100 has been invested in the purchase of Consols, which sum exceeds by £5 the amount received for life compositions.

The donations to the Society's library have been both numerous and important. They consist principally of the publications of scientific societies which have been received in exchange for your 'Transactions.' Twenty volumes have been bound during the year, and there are altogether about 120 volumes in the library, nearly all of which have been acquired by donation and exchange. These are all available for circulation, and in addition to them there is a considerable number of unbound pamphlets and portions of the proceedings of scientific societies, etc., which will in time form a valuable Natural History library.

It is to be regretted that on account of the books not being readily accessible but little use is made of them; but the Council hope shortly to be able to make arrangements by which the library belonging to the Society may become of more general service to the members.*

For the use of the rooms in which the evening meetings are held, and for other facilities afforded to the Society, the Council have again to express their thanks to the Committee of the Watford Public Library.

* These arrangements were made by, and announced at, the following meeting—see page xx.

INCOME AND EXPENDITURE DURING THE YEAR ENDING 31ST DECEMBER, 1877.

Dr.	£	s.	d.	Cr.	£	s.	d.
Balance	18	9	8	Books and Stationery	2	6	7
Subscriptions for 1876	2	10	0	Advertising	0	8	0
„ „ 1877	58	0	0	Printing 'Transactions'	33	18	0
Entrance Fees	10	10	0	Miscellaneous Printing	8	6	0
Life Compositions	20	0	0	Reporting	2	2	0
Sale of 'Transactions'	0	13	0	Rent — Watford Public Library	5	0	0
				Attendance at ditto	1	2	6
				Expenses of April Meeting	1	1	0
				Library	5	13	6
				Desk slope	0	10	0
				Postages	7	19	8
				Sundry small expenses	1	2	9
				Amount transferred to Capital Account	25	0	0
				Balance	15	12	8
	£110	2	8		£110	2	8
Subscriptions received for 1878	10	0	0	Investment in Consols, March, 1877	100	0	0

Audited and found correct, { JOHN ATTFIELD,
February 2nd, 1878, { CHAS. A. BOOTH.

ORDINARY MEETING, 10TH MARCH, 1878.

ALFRED T. BRETT, Esq., M.D., President, in the Chair.

Mr. Henry Wyman, Hemel Hempstead, was elected a Member of the Society.

The following paper was read:—

“On British Butterflies.” By the Rev. C. M. Perkins, M.A. (*Vide* p. 63.)

Mr. Arthur Cottam gave some particulars of his own experience in collecting. With regard to the female orange-tip (*Anthocaris Cardamines*) being mistaken for the Bath white (*Pieris Daptidice*), he remembered an instance of the reverse—*Daptidice* mistaken for the female *Cardamines*. He had had the pleasure of taking a male *Daptidice* at Margate in 1868, and a few minutes later he took *Argynnis Lathonia* and about twenty specimens of *Colias Hyale*. Although this was usually rare, it was sometimes as abundant as *C. Edusa*. In 1868 he saw a good many on the South Coast, although none had been seen there for some years before. He believed that *Hipparchia Semele* was chiefly found in the Chalk districts. It settled with its wings closed, and in this state it could scarcely be distinguished from the chalk. Several specimens of the Camberwell beauty (*Vanessa Antiopa*) were seen in the neighbourhood of Hoddesdon in 1875, and it had certainly been also seen in Middlesex.

Mr. Sydney Humbert said that he had been told by his brother, who had lived in Spain, that the swallow-tail (*Peucedanum palustre*) was as common there as the cabbage whites (*Pieris Brassicae* and *Rape*) were in England, and that it flew in the air like a bird, rising to a great height. He had brought a few specimens of it to show, and a few others which, though very scarce in England, were just as common abroad. He mentioned an instance of the Camberwell beauty having been seen by a farmer in a harvest-field on the eastern side of the county.

The President inquired whether different species of butterflies could be distinguished by their scales. He quite agreed with Mr. Perkins that it would be desirable to have a record kept of the rarer insects which might be found in the county, and suggested that he (Mr. Perkins) might act as registrar.

The Author replied that many, if not most, species of butterflies could be distinguished by their scales, when these were examined under the microscope. He would willingly undertake the task of registering any observations on insects that might be sent to him.

The President announced that the Council had arranged with the assistant-librarian of the Public Library that members might exchange books any week-day, from 3 to 5, and from 7 to 10 p.m.

ORDINARY MEETING, 11TH APRIL, 1878.

ALFRED T. BRETT, Esq., M.D., President, in the Chair.

The following lecture was delivered:—

“On the Physical Characteristics of Minerals.” By James U. Harford. (*Vide* p. 104.)

Specimens of minerals offering examples of all the different characteristics mentioned, and models of crystals, etc., were exhibited, and some experiments illustrative of the lecture were made by the Author.

The Honorary Secretary announced that the first donation of microscopical slides had been received since the previous meeting, five slides having been presented to the Society by Lieut. Croft, F.L.S. He hoped other members would soon follow the example set them by Mr. Croft.

FIELD MEETING, 4TH MAY, 1878.

CASSIOBURY PARK, TEMPLE OF PAN, AND LANGLEYBURY.

A numerous party, with a considerable majority of ladies, assembled at the principal entrance to Cassiobury Park at 3 o'clock, and, some in carriages, some on foot, proceeded through the Park to the Swiss Cottage.

As this was visited at the last field meeting in 1877, its rustic grounds did not long delay the party. After crossing the river and canal, and again entering the Park, the magnificent avenue of lime trees, and the avenue of wych elms, about three-quarters of a mile in length, which crosses it at right angles, were inspected and admired.

The members then left the Park, and, wending their way along the picturesque wood-walks of the Whippendale valley, crossed the Rickmansworth road near the gamekeeper's cottage. Availing themselves of the kind permission of the Earl of Clarendon, they now plunged into the charming woods which extend in a north-westerly direction towards Chipperfield. After rambling for some time in these woods, the party assembled for a short rest at the Temple of Pan, where refreshments, which proved to be very

acceptable, were very kindly provided by Mr. Littleboy, under whose direction the arrangements of the day had been placed.

The Temple of Pan, perhaps better known among the surrounding agricultural population as "Sheepshead Hall," is a rustic building or summer house, apparently dedicated to the memory of the grotesque Arcadian Deity whose name it bears. It is beautifully situated, being surrounded on all sides by woods, and with wide grass glades, fringed by tall firs and other ornamental trees, converging towards it from different directions. The exterior of the building is decorated with a complete cornice composed of the skulls and horns of rams; and the interior is appropriately ornamented by drawings of shepherds and shepherdesses, Pandean pipes, shepherds' crooks, and other sylvan appliances. A patch of Solomon's seal (*Polygonatum multiflorum*), the only rare botanical find of the day, and possibly not here truly indigenous, was discovered within sight of the Temple; and purely white hyacinths, a sport from the common bluebell, were met with in considerable abundance.

Langleybury, the seat of Mr. William Jones Loyd, was next visited, and by his direction the members were conducted by the gardener through the grounds adjacent to the house. A fine old cedar attracted special attention, and its dimensions were stated to be: girth of trunk, 21 feet 3 inches; height, 105 feet; spread of branches, 106 feet. The yew hedges, the tall hollies in the rookery, and the beautiful beech tree near the Parsonage, were also noticed; and it was remarked that the cedar, the yew, the holly, and the beech, appeared to find, in the gravels of this district, a very congenial soil.

Mr. Littleboy then conducted the party across the Canal lock to his residence near Hunton Bridge, and some time was spent in examining his fernery, and in viewing his picturesque garden, through which flows the river Gade, adding not a little to its attractions.

The members were then entertained at tea by Mr. and Mrs. Littleboy, after which, in the absence of the President, who had been obliged to leave before tea, a vote of thanks to the host and hostess was proposed by the Honorary Secretary and carried by acclamation. The members then left for Watford by the Hempstead Road.

ORDINARY MEETING, 9TH MAY, 1878.

ALFRED T. BRETT, Esq., M.D., President, in the Chair.

Miss Johnson, Langley Hill, King's Langley, was elected a Member of the Society.

The following communications were read:—

1. "Meteorological Observations taken at Cassiobury House from January to April, 1876." By the Right Honourable the Earl of Essex. (*Vide* p. 89.)

2. "Meteorological Observations taken at Holly Bank, Watford, during the half-year ending 31st August, 1877." By John Hopkinson, F.L.S., F.M.S., etc., Hon. Sec. (*Vide* p. 91.)

3. "Report on the Rainfall in Hertfordshire in 1877." By the Honorary Secretary. (*Vide* p. 97.)

4. "Report on Phenological Observations in Hertfordshire in 1877." By the Honorary Secretary. (*Vide* p. 101.)

5. "Notes for Observations of Injurious Insects." By Eleanor A. Ormerod, F.M.S. Communicated by the Honorary Secretary. (*Vide* p. 77.)

6. "Notes on Economic Entomology." By Eleanor A. Ormerod. Communicated by the Honorary Secretary. (*Vide* p. 84.)

FIELD MEETING, 18TH MAY, 1878.

TYLER'S HILL, CHESHAM.

At various places beyond the northern limit of the London Tertiary Basin outliers of the Lower Eocenes occur, ranging on the whole in a line parallel with the margin of the main mass of which they at one time formed a part. One of these, separated from the main mass by a greater distance than is usually the case, is at Tyler's Hill, or Cowcroft, as it is sometimes called, a mile and a half to the east of Chesham. The nearest railway station is at Boxmoor, and here, at about a quarter to three, a party consisting of members of the Society and of the Geologists' Association of London, assembled for the purpose of visiting this outlier under the guidance of Mr. John Evans, D.C.L., F.R.S.

The distance being five miles each way, a wagonette was engaged which the ladies of the party availed themselves of. An ascent by Box Lane had first to be made, and for about a quarter of a mile up the hill the Chalk was seen to come to the surface, sections being exposed in several small pits, and in the road-side banks, owing to the road being excavated to reduce its steepness.

On the higher ground the Chalk is covered for a considerable distance with "brick-earth" and "clay-with-flints." This elevated plateau, some 500 feet above sea-level, suddenly ends at Layhill Common, which is approached by a steep descent to the Chalk, here exposed by the erosion of a stream, no longer in existence, which at one time must have joined the Chess near Flaunden. From Layhill Common, where the Chalk is covered by glacial gravel, there is a gentler rise of the ground towards the outlier, which is conspicuous for some distance by the dense wood which covers it. The presence of this wood seems to be entirely due to the existence of the outlier of which Tyler's Hill is formed; and to this outlier the protection of the hill itself from denudation is, no doubt, also due. A chalk-pit and brickfields expose a complete section of the hill from the London Clay down to the Chalk.

The following description of this section is given by Professor

Prestwich in his paper on "The Woolwich and Reading Series," communicated to the Geological Society in 1853.*

		Feet.
	Gravel, chiefly of flint-pebbles in clay, averages	4
London Clay.	{ <i>b.</i> Brown clay with a few nodular septaria	10
	{ <i>a.</i> Layers of laminated grey and brown clay.....	3
Basement Bed of the London Clay, 3½ feet.	{ <i>c.</i> Layer of imperfect septaria full of fossils †	0½
	{ <i>b.</i> Light brown sandy clay	2
	{ <i>a.</i> Flint-pebbles in clay	1
	{ <i>h.</i> Umber-coloured clay, in places slightly mottled red and yellow	2
	{ <i>g.</i> Fine siliceous sand, in places very white	3
	{ <i>f.</i> Light-coloured soft sandstone with an occasional pebble—variable	1
Woolwich and Read- ing Series, 31 feet.	{ <i>e.</i> Light-coloured siliceous sands with a few seams of grey clay, the lower part coarser, yellow, and brown	10
	{ <i>d.</i> Laminated grey and yellow clay and sand, with an under-seam of pebbles	1
	{ <i>c.</i> Yellow and ash-coloured sand with seams of grey clay	8
	{ <i>b.</i> Grey clay laminated with sand	4
	{ <i>a.</i> Large unrolled flints, apparently white-coated.....	2
		51½
Chalk.....		25

Several sections exposed in the brickfields at various parts of the hill were examined, and at the chalk-pit Mr. John Evans drew attention to the perfectly level surface of the Chalk, which seemed, he said, to be a surface of marine denudation.

After returning to Boxmoor the chalk-pit on Rough Down, chiefly known as the place from which Mr. Evans has obtained most of the fossils of the Chalk-rock, was to have been visited, but tea proved a greater attraction, and there was not time to spare for both; so, after only a distant view of the band of chalk-rock, which here divides the Upper from the Lower Chalk, the party separated, most of the members of the two societies leaving Boxmoor station by the 7.37 train for Watford and London.

FIELD MEETING, 1ST JUNE, 1878.

ST. ALBANS.

The object of this meeting was to collect, in conjunction with members of the Quekett Microscopical Club, microscopic objects in ponds in the neighbourhood of St. Albans.

For this purpose members of the two societies assembled at the London and North-Western Station on the arrival of the train from London and Watford at about half-past three, and, after walking a short distance along the line, took a lane leading towards

* 'Quart. Journ. Geol. Soc.,' vol. x. p. 90.

† The *Ditrupea plana* abounds, together with *Ostrea Bellovacina*, a few *Natica glaucinoides*, a *Fusus*, and teeth of *Lamna*.

New Barnes, finding on their way specimens of the moss *Funaria hygrometrica*, which forms such an interesting object under the microscope, from the twisting of the peristome-teeth on the application of moisture.

On arriving at New Barnes the party separated, some visiting Mrs. Worley's garden, by her kind permission, and others collecting microscopic objects in the adjacent ponds.

In the garden the fine old cedar standing in front of the house first attracted attention. It is a very old tree, but its precise age is not known. It has been much broken by storms, and every fresh winter leaves its mark upon it. Under the guidance of the gardener, Mr. Logan, under whose superintendence the garden has been brought to its present picturesque state, the conservatory, replete with handsome foliage and flowering plants, was next visited, and then the out-door ferneries, rich in rare species of ferns, were inspected. After noticing a few old chestnut and beech trees, which had attained to handsome dimensions, and paying a hurried visit to the vineries and hothouses, the party left the garden to join those who were collecting in the ponds.

A path across the fields was then taken to St. Albans, and St. Peter's Church was soon reached—the nearest route to Bernard's Heath, which was next to be visited. On arrival here a few interesting objects were collected in the various pools in and near the brickfields, and then a narrow winding lane was followed to the Redbourn Road. Crossing this road a further descent was made to St. Michael's, and at Kingsbury* the party were entertained at tea by Mr. and Mrs. Willshin.

After tea, which was served partly in the house and partly in the garden, the members of the Quekett Club at once left to return to London by the Midland line, while the rest of the party stayed for some time for a stroll round the garden, and then took the picturesque "Water-walk" to the North-Western Station for Watford.

The meeting was under the direction of Mr. Frank W. Silvester and the Honorary Secretary.

* According to Chauncy ('Hist. Antiq. Herts,' p. 463) "The Mannour of Kingsbery" was "so termed from the Saxon Kings, who were the ancient Possessors hereof, and often resided and kept their Court there." The identity of the present spot, beautifully situated as it is on the banks of the river Ver at the extreme west of St. Albans, with the site of the ancient palace, seems proved by Chauncy's words. "There was," he says, "a stately Pallace that belonged to the Castle of Kingsberry, scituated at the West End of the Town of St. Albans, where the Saxon Kings delighted much." He then says that King Etheldred sold to the Abbot and Monks of St. Albans "all the royal Mannor of Kingsbery, with the Parks and Woods belonging to it, excepting one small Fortress near the Monastery, which the King would not suffer to be demolisht, that the Marks of his royal House might not be forgotten." Traces of the foundations of some of these buildings are still to be seen at the back of the present house.

ORDINARY MEETING, 13TH JUNE, 1878.

ALFRED T. BRETT, Esq., M.D., President, in the Chair.

Mr. James Vincent Elsdon, B.Sc., F.C.S., North Crescent, Hertford; Miss Selby and Miss Nellie Selby, Batler's Green, Aldenham; and Miss Stevenson, Chalk Hill, Bushey, were elected Members of the Society.

The following communications were read:—

1. "Note on the Recent Flood at Watford." By the President.

Dr. Brett stated that the flood on the 11th of April was the highest in the memory of the oldest inhabitant of Watford. It was remarkable for its rapid increase, rising at the rate of one foot per hour, and decreasing as rapidly. While, also, floods at Watford usually occurred about twelve hours after the rain, this one was much sooner felt.

2. Note on the finding of the Hertfordshire Conglomerate *in situ* close to Radlett Church. By the Rev. T. Marsden. Communicated by the President.

3. Notice of the occurrence of a Landslip in Rickmansworth Park, in May, 1876. Communicated by the Honorary Secretary.

4. "On the Fertilisation of *Aucuba Japonica*." By the President. (*Vide* p. 111.)

5. On a Stone found embedded in the Centre of a Beech Tree. By the President.

Dr. Brett stated that during the storm which sank the "Eurydice" one of the finest beeches in Cassiobury Park, at the principal entrance, was blown down, and that, when the sawyers cut through the tree, about fifteen feet from the ground, they found a stone in the centre. On examining the tree, it was found that three branches had grown together round the stone, which must have been thrown into the fork (or axil) of these branches when the tree was very young.

6. A letter from "Two Members," Nutfield, Watford, to the Secretary, on the growth of Mistletoe on the Hawthorn in Cassiobury Park.

7. Extract of a letter from Mr. H. George Fordham, F.G.S., Odsey Grange, Royston, to the Secretary, on the Bee Orchis (*Ophrys Apifera*) near Odsey.

Mr. Fordham had recently found several plants of the bee orchis in a new locality on a patch of glacial sand and gravel just within the County of Hertford, where the parish of Ashwell adjoins that of Odsey. It was interesting, in this neighbourhood, he said, to observe the complete change in the character of the flora when these isolated patches of glacial drift were met with.

8. "Notes on the May-fly." By Peter Hood, M.D. (*Vide* p. 107.)

9. "On the Otter and Badger in the Valley of the Colne." By the President.

Dr. Brett said that an otter had been shot by Mr. Ruby at Iver Moor on the River Colne; and that Mr. Grass, keeper to the Earl of Essex, shot a badger at Long Spring early in May last, being the first badger he had seen during the thirty-six years he had lived as keeper at Watford.

10. Extract of a letter from Mr. R. P. Greg, F.G.S., Coles Park, Buntingford, to the Secretary, stating that badgers were not uncommon in the Rib near Buntingford, and that his keeper had shot one last August.

11. "On a Singular Disease amongst the Deer in Cassiobury Park." By the President. (*Vide* p. 111.)

12. "On Natural Selection in Rabbits." By the President. (*Vide* p. 112.)

The attention of the Society was also drawn to some photographs showing peculiar markings on the panes of glass of a conservatory, sent by Lieut. R. B. Croft, F.L.S., who was desirous of eliciting suggestions as to their origin.

Several Members exhibited objects under their microscopes, and other interesting Natural History objects were exhibited.

FIELD MEETING, 16TH JUNE, 1878.

HERTFORD AND WARE.

The northern edge of the London Tertiary Basin passes for a considerable portion of its course through the County of Hertford, and within the last few years several places along this line of outcrop have been visited by the Society, in conjunction with the Geologists' Association of London. On this occasion the neighbourhood of the county town was selected for investigation, and members of the two societies met at the Hertford Station of the Great Northern Railway at half-past ten, the County Field Club forming by far the larger party. Professor John Morris, F.G.S., had kindly consented to explain the geological features of the district, the Honorary Secretary having made the necessary arrangements for the day, and selected the route to be taken.

The first place visited was Hertford Castle, near which there are still standing, completely overgrown with ivy, the ruins of a much older structure, once an important fortress, supposed to have been built by King Alfred. Near this fortress flows the River Lea, from which the moat by which it was surrounded could have been easily filled.

From the Castle the route lay through the churchyard (All Saints'), famed for its fine avenue of chestnuts, 200 years old, and thence through Balls Park, the seat of the Marquis Townshend, to Mr. Lines' brickfield, between Rush Green and Hertford Heath, the first point of geological interest. Before, however, the brickfields were visited, a chalk-pit near afforded Professor Morris the text for an interesting address, in the course of which he showed that the flints immediately above the chalk were of a different colour from that of the flints in the chalk, some chemical change having given them a green coating. The presence of this thin layer of green-coated flints, known to borers as the "Bull's Head Bed," was a proof that we had the true surface of

the Upper Chalk, the bed forming the basement of the Tertiary Series. Another interesting point connected with the chalk here was that it contained very little silex, for it had segregated in the form of flints; while, in the Lower Chalk, or chalk without flints, the silex was probably distributed through the mass. Mr. Lines, who here joined the party, stated that in the bed of green-coated flints, sharks' teeth and oyster shells (*Ostrea Bellocacina*) were frequently found.

Various sections exposed in the brickfields were then examined, the Professor explaining the relative position of the different beds, and their relations to each other, and to beds elsewhere which are here wanting.* In this district we had, he said, the lowest portion of the Tertiary Series seen north of London, but not the lowest known in the London area, for while the Thanet Sands were being deposited south of the Thames, the Chalk here was nearer the surface, not allowing of their deposition. The Woolwich and Reading Beds also were only partially represented. They consisted here of alternations of sands and clays, and showed a very different set of conditions to that on the south of London, where there were thirty or forty feet of ash-coloured sands. Here also, there were no freshwater shells, though these beds were contemporaneous with the freshwater beds found at Lewisham, etc., which contained a great number of shells; for, while south of London there were freshwater and estuarine conditions, in the north and west of the London Tertiary Basin the deposits were entirely marine.

Other beds, which form a passage between the Woolwich and Reading Series and the London Clay, were next examined, and Professor Morris stated that they represented an important change of conditions. Their black flint-pebbles were interesting as being derived from unworn flints perfectly rolled on some sea-shore, and, after being rounded, spread over the surface where they were now found. These higher beds, forming the basement-bed of the London Clay, evidenced a great depression of a very large area, extending between Marlborough, Hungerford, and Harwich.

From the brickfields the route lay across the fields to the hamlet of Hertford Heath, the highest point visited during the day, where excavations are being carried on under the direction of Messrs. Smith & Austin, of Hertford, for a reservoir to supply the village with water. Here the Professor continued his lecture on the geology of the neighbourhood. Few districts were, he said, so interesting geologically as this, which had been partly worked out by Professor Hughes.† Other heights of the same level were seen around, and these elevations were the remnants of a surface of uniform height which had been cut into deeply by denudation, the

* A detailed account of the entire section exposed in these brickfields will be found in the lecture by Professor Morris, on "The Physical Structure of the London Basin," in the 'Transactions,' Vol. I, p. 99.

† See 'Quart. Journ. Geol. Soc.,' vol. xxiv, p. 283.

present river-valleys being then formed and gravel being deposited. The gravel beds of the higher levels might be seen to contain pebbles from a great distance—Wales, Cumberland, and even Scotland. They were the high-pebble gravels of Professor Hughes. It was improbable that they were here first formed in place as pebbles, some at least being pebbles of far older age. After the pebbles were deposited an emergence took place, and the land became scooped out, and great valleys were formed. During a period of submergence the glacial or Boulder-clay materials were brought from the north, and here the Boulder-clay was seen to have mixed up the gravel of high-pebbles and to have brought with it other materials. After this period a partial emergence took place, and after this emergence rain and rivers gave the present contour to the country, forming the third or river-gravel period, so that the district now presents the beds of high-pebble gravel, boulder-clay and gravel, and low-pebble gravel.

From Hertford Heath the route lay through the “Walnut-tree Walk,” and in refreshing shade, for the day was hot and the sun shone brightly, a halt was made for luncheon, after partaking of which the party passed through Amwellbury, the romantic grounds of the Rev. F. D. Barclay Bevan, by permission of the Misses Bevan, and came upon the high road near the Amwell Hill limekilns, where a few fossils were found, and some fine examples of vertical “pipes,” exposed at the sides of an extensive chalk-pit, were specially noticed.

Climbing one of the sides of the pit, Amwell Magna* was almost immediately reached, and the well-known spring which rises here from the Chalk, affording the New River Company a copious supply of water, was visited; but the beauty of the spot—the church above, the river flowing by, the finely-wooded hill-side, and the ornamental water reflecting the varied scene—diverted attention from the spring, and from the interest attaching to its situation and origin. It is evidently a subterranean stream, flowing for some distance in the Chalk towards the River Lea, then passing under it and rising on the other side, and finding its way to the surface close to the river under which it flows.

The next point of interest was near the New River Head, on the road from Ware to Hertford. Here a boring is in progress by the Diamond Rock Boring Company to afford an additional supply of water for the New River Company. On arriving at the scene of operations, the party, by permission of the New River Company, and of Colonel Beaumont, R.E., Director of the Diamond Rock Boring Company, had the opportunity of becoming acquainted with the various methods of working adopted. The first operation consists in sinking by means of compressed air,—men working inside an iron cylinder into which air is pumped, which drives out round the edges any water which may accumulate while the materials are loosened inside, the cylinder being forced down

* Or Great Amwell, the *Emmewelle* or Emma's Well of Domesday Book.

from above. This preliminary process had been given up, and the boring by diamonds had been carried on for some time. The boring, commenced in February, had been carried to a depth of 250 feet—a quarter of the entire distance intended—at an expense in diamonds alone of over £400; for although the diamonds rapidly cut away the hardest rock without showing any signs of wear, they become loose and break away by the wearing of the steel rings in which they are fixed. They are set in rows tangentially at the bottom of a ring of varying dimension (called the “crown”), the larger rings which are first used being made to revolve more slowly than the smaller ones used at greater depths where the bore-hole has to be smaller. At the present stage a ring $19\frac{1}{2}$ inches in diameter, making from 100 to 125 revolutions per minute, is being used, the motion being given by a 25-horse-power steam-engine. After explaining the working of the machinery, and showing some of the cores which had been brought up, Mr. Wild, the Resident Engineer, most obligingly set his men to give a practical illustration of some of the processes, and the method of “drawing the core” and washing-out the “sludge” was duly exemplified.

The Chadwell Springs, a few fields distant—better known as the New River Head—were next to have been visited, and the “Ermine Street,” an old Roman road, and other indications of olden times, to have been explored, but evening was drawing near, and the party had to hasten from the boring to Ware Priory, the residence of Dr. J. Gwyn Jeffreys, F.R.S., etc., who had invited the members of the two societies to tea. Here a sumptuous meal was provided, and after full justice had been done to it, Professor Morris, as President of the Geologists’ Association, proposed a vote of thanks to Dr. and Mrs. Gwyn Jeffreys for their kind entertainment, which was seconded by Dr. Brett, as President of the County Society, and carried by acclamation.

Dr. Gwyn Jeffreys, in responding, referred to the long and tiring walk his visitors had accomplished, which he was sure was good for them, and for the ladies especially, of whom he was glad to see so many present. He was very pleased to see them at the Priory, and hoped this would not be the last visit they would pay him.

The party then took leave of their host and hostess and left the Priory for Ware Station, the members of the Geologists’ Association returning to London by the Great Eastern Railway, and most of the members of the Hertfordshire Field Club to Hertford, in the opposite direction, and thence to Watford and elsewhere.

FIELD MEETING, 3RD JULY, 1878.

MOOR PARK.

A large number of members and their friends left Watford for Rickmansworth by the 2.30 p.m. train, to visit Moor Park by the invitation of Lord Ebury, and at the park were joined by others who had driven from Watford and elsewhere.

The "Cottage Gardens" were first visited, and here, amongst a number of fine old trees, a tulip-tree of unusually handsome growth was specially noticed. Entering then the park just beyond these gardens, the beautiful "lime-tree walk" was taken towards Moor Farm. The trees now growing at the side of this walk were planted about 150 years ago, and are now quite perfect, but of the limes of older date one only is now standing. Selby, in his 'History of British Forest Trees' (p. 6), specially refers to these limes as showing that where sufficient room has been afforded to the lime-tree, "and the soil has suited its constitution," it becomes one of "the finest and most striking of our forest-trees."

That the roots of these trees must penetrate into the chalk evidence was afforded by a chalk-pit near, the chalk being seen to come almost to the surface. The bands of flints, cutting the surface-line of the chalk at an angle, showed also that the true or original surface of this—the Upper—Chalk was not seen, some portion, perhaps considerable, having been denuded, probably by the river, then flowing at a much higher level than now. The Colne seems, in fact, to have been mainly instrumental in forming the escarpment of the London Clay and Woolwich Beds which here overlooks its present valley.

The few existing indications of the old Moor House near the Watford entrance to the park were next examined. The site of the once fortified mansion, a nearly square piece of ground artificially raised, estimated by pacing to be about an acre in extent, was seen to be still protected on three of its sides by the moat, and the position of the drawbridge in the centre of the fourth side, by which it is approached, was clearly traced.

The members then proceeded in the direction of the present Moor House along the "King's Drive," so named because it was the route taken by William the Fourth on his visit to the Marquis of Westminster in 1833. Passing the house the upper pleasure grounds were visited, and here the principal object of interest was an old fir tree, supposed to be the largest and oldest spruce fir in Great Britain. It appears to be a clump of firs, but is really only one tree, some of the branches of which have bent down to the ground, taken root, and sent forth fresh branches. The pleasure grounds are about twenty-five acres in extent, and from their elevated position afford splendid views of the surrounding country.

Beyond these grounds a halt was made at the "Bath End Clump," near to which Wolsey's Oak, or the Cardinal's Oak, as it is sometimes called, was noticed; * and towards the Batchworth Heath entrance to the park, through the "Surrey Gap" were seen the distant hills of Surrey.

* The Rev. Canon Gee, in his paper on "Famous Trees in Hertfordshire" ('Transactions,' Vol. II, p. 13) refers to this tree, and also gives some historical information as to the origin of the pollard oaks in Moor Park.

Returning to the house, tea and other refreshments, kindly provided by Lord Ebury, were partaken of in the gardens immediately adjoining it, and then the house itself was entered. The richly decorated entrance-hall was first examined, and the paintings of mythological subjects on the walls, by Amiconi, a Venetian artist, were explained by the President, Dr. Brett, who also gave some interesting information as to the history of the house under its successive owners, and especially as to its almost entire reconstruction, between 1720 and 1739, when the property of Mr. Styles, by Leoni, a celebrated Italian architect, under whose direction these paintings and most of the present decorations throughout the house were done.*

After visiting various rooms, a vote of thanks was accorded to the present noble owner, in moving which Dr. Brett stated that Lord Ebury regretted that he was unable to receive and entertain the members of the Society himself, being unavoidably engaged in London on that day.

The members then dispersed, most of them returning to Watford from Rickmansworth Station.

ORDINARY MEETING, 10TH OCTOBER, 1878.

ALFRED T. BRETT, Esq., M.D., President, in the Chair.

The Rev. Herbert R. Peel, M.A., Abbot's Hill, Hemel Hempstead, and the Rev. E. T. Vaughan, M.A., The Parsonage, Hunton Bridge, were elected Members of the Society.

The following lecture was delivered:—

“The Origin and Present Distribution of the British Flora.”
By the Rev. George Henslow, M.A., F.L.S., F.G.S. (*Vide* p. 129.)

Maps, diagrams, and botanical specimens were exhibited by Mr. Henslow in illustration of the lecture.

ORDINARY MEETING, 14TH NOVEMBER, 1878.

ALFRED T. BRETT, Esq., M.D., President, in the Chair.

Captain George Ernest Ross, F.R.G.S., Waterside, St. Albans; and Forfar House, Cromwell Road, South Kensington, London, S.W., was elected a Member of the Society.

The following paper was read:—

“The Bulborne and Gade, with Notes on the Fish of the two Rivers.” By John E. Littleboy. (*Vide* p. 113.)

* Salmon, in writing in 1728 of these alterations to the house, says: “A North Front of the same is designed, the Hill towards Watford being cut through for a Visto; in digging were found Veins of Sea Sand with Muscles in it” (*Hist. Herts.*, p. 110). The basement-bed of the London Clay must have been here cut through.

The President alluded to the present scarcity of minnows in the Colne, though formerly they were so abundant that a minnow feast was held annually at Watford. He also referred to the absence of any certain knowledge as to the length of life of fishes.

Mr. Sydney Humbert mentioned having caught a bream in the Gade, near Russell Farm, four pounds in weight, and stated that he knew the pope to be frequently caught in the Gade. Referring to the voracity of the pike, he said that he was fishing one day in company with a friend and each hooked a fish almost at the same moment. A single pike had taken both their baits, and was thus doubly caught.

Numerous stuffed specimens of the different fish referred to were exhibited, most of which were lent by Mr. Burbidge, Mr. Moon, and Mrs. Moore.

ORDINARY MEETING, 12TH DECEMBER, 1878.

ALFRED T. BRETT, Esq., M.D., President, in the Chair.

The following communications were read:—

1. "Notes on the Botany of the Experimental Grass Plots at Rothamsted, Herts." By John J. Willis. Communicated by the Honorary Secretary. (*Vide* p. 140.)

2. "Note on *Eucalyptus globulosa* at Watford." By the President. (*Vide* p. 156.)

3. "Note on the Fertilisation of *Aucuba Japonica*." By Ricardo Palmer. Communicated by the President. (*Vide* p. 156.)

4. Extracts from a letter from the Rev. J. C. Clutterbuck, M.A., to the President, on the Watford Rivers and their Fish.

Mr. Clutterbuck stated that the heaviest trout he ever heard of was caught in the Colne at Rickmansworth. It weighed 11 lbs. and was said not to be in full condition. He referred to the great destruction the paper mills had wrought, especially the one on Rickmansworth Common Moor. He had observed that, in the Thames, trout were only found where there was a Chalk or Oolite stream which brought them into the main river, and then they were few but generally large. They avoided rivers subject to floods, as the Thames and the upper part of the Colne. He could not understand why the Ver lost its name at its junction with the Colne, which scarcely deserved the name of a river above the junction. Telford, in the plan accompanying his report, called the river the "Verlam" far below the junction.

5. A letter from Mr. Stephen Austin to the Secretary, on the discovery of remains of a stag (*Cervus Elaphus*) in a bed of peat in Panshanger Park.

Mr. Austin stated that a pair of very fine antlers and fifteen pieces of vertebræ had recently been taken from a peaty place in Panshanger Park. Some men were cutting a watercress bed and in digging they came upon the point of an antler. The pair of horns which they found in digging further were perfect and very large—3 feet long and 21 inches spread, and just above the place where attached to the head, 7 inches in circumference. They were in perfect preservation, and looked as if they might have just been taken from a live stag. From their shape Mr. Austin concluded that they must have belonged to *Cervus Elaphus*. He had never heard of deer having been kept in Panshanger.

DONATIONS TO THE LIBRARY IN 1878.

TITLE.	DONOR.
ANON. Rudiments of Vegetable Physiology. 8vo. Edinburgh, 1846	<i>Mr. J. Hopkinson.</i>
BAYNE, REV. R. Rickmansworth and its Neighbourhood. 8vo. London and Aylesbury, 1870	<i>Dr. A. T. Brett.</i>
COUES, ELLIOTT. Fur-bearing Animals: A Monograph of North American Mustelidæ. (<i>U.S. Geol. Surv.</i>) 8vo. Washington, 1877	<i>Prof. F. V. Hayden.</i>
COUES, E., and J. A. ALLEN. Monographs of North American Rodentia (<i>U.S. Geol. Surv.</i>) 4to. Washington, 1877	"
DREW, DR. JOHN. Practical Meteorology. 8vo. London, 1855	<i>Mr. J. Hopkinson.</i>
EVANS, DR. JOHN. Address to the Geological Section of the British Association, Dublin, 15th August, 1878. 8vo.	<i>The Author.</i>
FRANCIS, F. J. A Brief Survey of Physical and Fossil Geology. 8vo. London, 1839	<i>Mr. J. Hopkinson.</i>
GEOGRAPHICAL MAGAZINE. Vol. v, Nos. 1-5. 4to. London, 1878	<i>Lieut. R. B. Croft.</i>
HARRISON, W. J. On the Occurrence of Rhætic Beds in Leicestershire. (<i>Quart. Journ. Geol. Soc.</i> 1876.) ———. On the Geology of Leicestershire. (<i>Proc. Geol. Assoc</i> 1877)	<i>The Author.</i>
———. Report of Excursion of the Geologists' Association to Leicestershire (<i>ib.</i> 1877)	"
———. A Sketch of the Geology of Hampshire. 8vo. Sheffield, 1877	"
———. The Geology of the West Riding of Yorkshire. (<i>Post Office Directory</i> , 1878)	"
HAYDEN, PROF. F. V. Geological and Geographical Atlas of Colorado, and Portions of Adjacent Territory. (<i>U.S. Geol. Surv.</i>) Folio. Washington, 1877	<i>Prof. F. V. Hayden.</i>
———. Ninth Annual Report of the United States Geological and Geographical Survey of the Territories, for 1875. (Colorado.) 8vo. Washington, 1877	"
JACKSON, W. H. Descriptive Catalogue of Photographs of North American Indians. (<i>U.S. Geol. Surv.</i>) 8vo. Washington, 1877	"
LESQUEREUX, LEO. Contributions to the Fossil Flora of the Western Territories. Part 2. The Tertiary Flora. (<i>U.S. Geol. Surv.</i>) 4to. Washington, 1878	"
LINNEAN SOCIETY. Journal. Zoology, Vols. xii-xiii. Botany, Vols. xv-xvi. 8vo. London, 1876-78	<i>Lieut. R. B. Croft.</i>
LIVERPOOL GEOLOGICAL SOCIETY. Proceedings. Sessions 1872-73 and 1873-74. 8vo. Liverpool, 1873-74	<i>Mr. J. Hopkinson.</i>
MICROSCOPICAL, MONTHLY, JOURNAL. Vols. xvii-xviii. 8vo. London, 1877	<i>Lieut. R. B. Croft.</i>
NICHOLSON, PROF. A. H. Introductory Text Book of Zoology. 2nd Edition. 8vo. Edinburgh and London, 1875	<i>Mr. J. Hopkinson.</i>
PATTERSON, ROBERT. Introduction to Zoology. Part 1. Invertebrate Animals. 12mo. London, 1846	"
POPULAR SCIENCE REVIEW. Vols. i-ii. 8vo. London, 1862-3	"

TITLE.	DONOR.
ROYAL SOCIETY. Report of the Committee of Physics, including Meteorology, on the Objects of Scientific Inquiry in those Sciences. 8vo. London, 1840 .	<i>Mr. J. Hopkinson.</i>
SCIENCE GOSSIP, 1878. 8vo. London, 1878 .	<i>The Publishers.</i>
SCOTTISH METEOROLOGICAL SOCIETY. Journal. New Series. Vol. iv, Nos. 43-46. 8vo. Edinburgh, 1875	<i>Mr. J. Hopkinson.</i>
SYMONS, G. J. British Rainfall, 1876. 8vo. London, 1877	<i>The Editor.</i>
———. ————, 1877. <i>Ib.</i> 1878	"
———. Monthly Meteorological Magazine. Vol. xiii. 8vo. London, 1878	"
UNITED STATES ENTOMOLOGICAL COMMISSION. Annual Report for 1877, relating to the Rocky Mountain Locust. (<i>U.S. Geol. Surv.</i>) 8vo. Washington, 1878	<i>Prof. F. V. Hayden.</i>
UNITED STATES GEOLOGICAL AND GEOGRAPHICAL SURVEY OF THE TERRITORIES. Bulletin. Vol. iii, No. 4. Vol. iv, Nos. 1 and 2. 8vo. Washington, 1877	"
———. Illustrations of Cretaceous and Tertiary Plants of the Western Territories. 4to. Washington, 1878	"
———. Preliminary Report of the Field Work for the Season of 1877. 8vo. Washington, 1877	"
WATTS, DR. J. The Knowledge of the Heavens and the Earth made easy. 5th Edition. 8vo. London, 1752	<i>Lieut. R. B. Croft.</i>
WHITE, DR. C. A., and PROF. H. A. NICHOLSON. Bibliography of North American Palæontology. (<i>U.S. Geol. Surv.</i>) 8vo. Washington, 1878.	<i>Prof. F. V. Hayden.</i>
WOODWARD, DR. JOHN. An Essay towards a Natural History of the Earth. 3rd Edition. 8vo. London, 1723	<i>Lieut. R. B. Croft.</i>

PUBLICATIONS OF SOCIETIES RECEIVED IN EXCHANGE.

- BARROW NATURALISTS' FIELD CLUB. Proceedings. Vols. i-ii. 8vo. Barrow-in-Furness, 1877-78.
- BATH NATURAL HISTORY AND ANTIQUARIAN FIELD CLUB. Proceedings. Vol. iv, No. 1. 8vo. Bath, 1878.
- BELFAST NATURAL HISTORY AND PHILOSOPHICAL SOCIETY. Proceedings. Session 1876-1877. 8vo. Belfast, 1877.
- BIRMINGHAM NATURAL HISTORY AND MICROSCOPICAL SOCIETY. Annual Reports for 1876-78. 8vo. Birmingham, 1876-78.
- . Notes on Sutton Park: its Flowering Plants, Ferns, and Mosses. By James E. Bagnall. 8vo. Birmingham, 1877.
- BOSTON [U.S.A.] SOCIETY OF NATURAL HISTORY. Proceedings. Vol. xix, Parts 1-2. 8vo. Boston, 1877.
- BRIGHTON AND SUSSEX NATURAL HISTORY SOCIETY. Proceedings for 1876-77. 8vo. Brighton, 1878.
- BRISTOL NATURALISTS' SOCIETY. Proceedings. New Series. Vol. ii, Part 1. 8vo. Bristol, 1877.
- CARDIFF NATURALISTS' SOCIETY. Transactions. Vol. ix. 8vo. London, 1878.
- CHESTER SOCIETY OF NATURAL SCIENCE. Annual Report for 1877-78. 8vo. Chester, 1878.
- CROYDON MICROSCOPICAL CLUB. Proceedings for 1876. 8vo. Croydon, 1878

- EASTBOURNE NATURAL HISTORY SOCIETY. Papers. Sessions 1873-74 to 1877-78. 4to. Eastbourne, 1874-78.
- EDINBURGH BOTANICAL SOCIETY. Transactions and Proceedings. Vol. xiii, Part 1. 8vo. Edinburgh, 1877.
- ENTOMOLOGICAL SOCIETY. Proceedings for 1877. 8vo. London, 1878.
- GEOLOGICAL SOCIETY OF LONDON. Abstracts of the Proceedings. Session 1877-78. 8vo. London, 1878.
- GEOLOGISTS' ASSOCIATION. Proceedings. Vol. v, Nos. 3-6. 8vo. London, 1877-78.
- GLASGOW NATURAL HISTORY SOCIETY. Proceedings. Vol. iii, Part 2. 8vo. Glasgow, 1877.
- GLASGOW, PHILOSOPHICAL SOCIETY OF. Proceedings. Vol. xi, No. 1. 8vo. Glasgow, 1878.
- IRISH, ROYAL, ACADEMY. Proceedings. Science. Series 2, Vol. iii, No. 1. 8vo. Dublin, 1877.
- . Aeneidea, or Critical, Exegetical, and Aesthetical Remarks on the Aeneis. By James Henry. Vol. i, and Vol. ii, Part 1. 8vo. Dublin, 1877-78.
- LEEDS NATURALISTS' CLUB AND SCIENTIFIC ASSOCIATION. Annual Report for 1877-78. 8vo. Leeds, 1878.
- LEICESTER LITERARY AND PHILOSOPHICAL SOCIETY. A Sketch of the Geology of Leicestershire and Rutland. By W. J. Harrison. 8vo. Leicester, 1877.
- LIVERPOOL GEOLOGICAL SOCIETY. Proceedings. Vol. iii, No. 3. 8vo. Liverpool, 1877.
- LIVERPOOL, LITERARY AND PHILOSOPHICAL SOCIETY OF. Proceedings. Vol. xxxi. 8vo. London and Liverpool, 1877.
- LONDON, WEST, SCIENTIFIC ASSOCIATION AND FIELD CLUB. Annual Report for 1877-78. 8vo. London, 1878.
- MANCHESTER GEOLOGICAL SOCIETY. Transactions. Vol. iv, Parts 15-22. 8vo. Manchester, 1877-78.
- MARLBOROUGH COLLEGE NATURAL HISTORY SOCIETY. Report for the half-year ending Christmas, 1877. 8vo. Marlborough, 1878.
- METEOROLOGICAL SOCIETY. Quarterly Journal. New Series. Vol. iii, No. 24, Vol. iv, Nos. 25-27. 8vo. London, 1877-78.
- MICROSCOPICAL, ROYAL, SOCIETY. Journal. Vol. i. 8vo. London, 1878.
- MIDLAND UNION OF NATURAL HISTORY SOCIETIES. The Midland Naturalist. Vol. i. 8vo. London and Birmingham, 1878.
- NORFOLK AND NORWICH NATURALISTS' SOCIETY. Transactions. Vol. ii, Part 4. 8vo. Norwich, 1878.
- PERTHSHIRE SOCIETY OF NATURAL HISTORY. The Scottish Naturalist. Vol. iv, Nos. 29-32. 8vo. Edinburgh and London, 1878.
- QUEKETT MICROSCOPICAL CLUB. Journal. Vol. v, No. 35. 8vo. London, 1877.
- RUGBY SCHOOL NATURAL HISTORY SOCIETY. Report for 1877. 8vo. Rugby, 1878.
- SOMERSETSHIRE NATURAL HISTORY AND ARCHÆOLOGICAL SOCIETY. Proceedings. New Series. Vol. iii. 8vo. Taunton, 1878.
- UNITED STATES COMMISSION OF FISH AND FISHERIES. Reports of the Commissioner for 1871-75. 8vo. Washington, 1873-76.
- WARWICKSHIRE NATURAL HISTORY AND ARCHÆOLOGICAL SOCIETY. Report for 1877. 8vo. Warwick, 1878.
- WILTSHIRE ARCHÆOLOGICAL AND NATURAL HISTORY SOCIETY. Magazine. Vol. xvii, No. 51. Vol. xviii, No. 52. 8vo. Devizes, 1878.
- WINCHESTER AND HAMPSHIRE SCIENTIFIC AND LITERARY SOCIETY. Journal of Proceedings. Vol. i. 8vo. Winchester, 1875.
- YORKSHIRE NATURALISTS' UNION. The Naturalist. Vol. iv, Nos. 1-5. 8vo. Huddersfield, 1878.

ORDINARY MEETING, 9TH JANUARY, 1879.

ALFRED T. BRETT, Esq., M.D., President, in the Chair.

Mr. Frederick Littleboy, Hunton Bridge, Watford, was elected a Member of the Society.

The following lecture was delivered:—

“Poisons not always Poisons.” By Professor John Attfield, Ph.D., F.C.S. (*Vide* p. 147.)

The President said that Prof Attfield's lecture proved the truth of the common saying—“What is one man's meat is another man's poison.” This was, however, more applicable to the lower animals than to man. He had often been struck with the deadly action of bruised laurel leaves on insects. The similar action of sulphur, whether applied in the solid form or as sulphurous acid fumes, was also remarkable. He had been told that caustic lime thrown into a pool would destroy any fish that might be in it, but he should have thought that the lime would be too much diluted for the fish to be injured. He did not consider the chalk in the Watford water to be injurious, for our constitution required lime, and we took more of it with our solid food than in water.

Mr. James Hopkinson said that it had long been known that if sufficient caustic lime were thrown into a pool to render the water perfectly white, the fish would rise to the surface dying or dead.

Mr. Littleboy stated that he had often eaten a considerable amount of the fruit of the yew, and it had never had any injurious effect, but he knew that the stone should not be eaten. The fruit of the Irish yew was more luscious than that of the common yew.

Mr. E. M. Chater said that there was one plant in particular the flowers of which had a poisonous effect upon insects and not upon the higher animals. He alluded to a species of *Pyrethrum*, which he believed formed the basis of most of the insect powders. It had occurred to him that as strychnine acted on the nervous system it might not have the same poisonous effect on mites as on more highly organised animals; and that as sulphate of zinc probably contained a large quantity of combined water, the spider might possibly have existed on the water, rejecting the mineral matter.

Professor Attfield replied that, with regard to bruised laurel leaves killing insects, the effect was doubtless due to hydrocyanic acid. Laurel leaves probably contained amygdalin, which when brought into contact with moisture, as in bruising the leaves, broke up into various compounds, one of which was hydrocyanic acid. At the same time there were animals, as frogs and toads, which would take a large quantity of this acid without injury. With regard to the action of lime on fish, a small quantity of lime thrown into water might be quickly converted into carbonate of lime or chalk, but a large quantity would act as caustic lime, which being a powerful alkali would not only kill, but even disintegrate animals. It was a well-known fact that *Pyrethrum carneum* was an insecticide, but *how* it acted was not known. It was also well known that even when given in considerable quantities it did not affect the higher animals, as dogs and cats. Mr. Chater's suggestion about strychnine might probably indicate the truth. Strychnine being a great nerve-paralyser would be a poison to all animals having nerves like man, but to those having a less complete organisation he could conceive that it might be a food, for though it resisted the action of hot oil of vitriol, which no other vegetable poison did, it was pretty easily oxidised, and oxidation was the leading feature in the digestion and assimilation of food. With regard to the action of poisons generally, the facts he had brought forward would seem to show that the substances called poisons were only truly poisons when the animals taking such substances were unaccustomed to them, or when the substances were swallowed in quantities larger than usual.

Mr. E. M. Chater and Mr. J. Watson Walker were appointed auditors of the accounts for 1878.

ANNUAL MEETING, 13TH FEBRUARY, 1879.

ALFRED T. BRETT, Esq., M.D., President, in the Chair.

The Right Honourable the Earl Cowper, K.G., Panshanger, Hertford, and Mr. Bernard C. Smith, Southfield House, Watford, were elected Members of the Society.

The Report of the Council for 1878, and the Treasurer's Account of Income and Expenditure, were read and adopted.

The President delivered an Address. (*Vide* p. 157.)

The Balloting-glass having been removed, and the lists examined by the Scrutineers, the following gentlemen were declared to have been duly elected as the Officers and Council for the ensuing year:—

President.—J. Gwyn Jeffreys, LL.D., F.R.S., F.L.S., F.G.S., etc.

Vice-Presidents.—Alfred T. Brett, M.D.; Arthur Cottam, F.R.A.S.; John Evans, D.C.L., LL.D., F.R.S., F.S.A., F.G.S., F.M.S.; R. A. Pryor, B.A., F.L.S.

Treasurer.—Charles F. Humbert, F.G.S.

Honorary Secretary and Librarian.—John Hopkinson, F.L.S., F.G.S., F.R.M.S., F.M.S.

Honorary Curator.—W. Lepard Smith.

Other Members of the Council.—Prof. John Attfield, Ph.D., F.C.S.; R. Russell Carew, F.R.G.S., F.C.S.; E. M. Chater; Lieut. R. B. Croft, R.N., F.L.S., F.R.M.S.; the Right Honourable the Lord Ebury; the Right Honourable the Earl of Essex; H. George Fordham, F.G.S.; James U. Harford; John E. Littleboy; J. Logan Lobley, F.G.S., F.R.G.S.; the Rev. C. M. Perkins, M.A.; Joseph Pollard.

It was then resolved—

That the thanks of the Society be given to Dr. Brett, retiring from the office of President; to Mr. J. Logan Lobley, retiring from the office of Vice-President; and to the Rev. Canon Gee, D.D., Mr. J. E. Harting, and Mr. F. W. Silvester, retiring from the Council.

REPORT OF THE COUNCIL FOR 1878.

In presenting their fourth Annual Report, the Council of the Watford Natural History Society and Hertfordshire Field Club have pleasure in congratulating the members on the continued prosperity of the Society and on the influential position it maintains in the County, its members being distributed over almost every part of Hertfordshire, and its Natural History investigations having an equally extensive range.

During the year sixteen ordinary members have been elected; three members have compounded for their annual subscriptions; eleven members have resigned; two members have been excluded from the Society for non-payment of their subscriptions for three years; and the Council regret that they have again to record the loss of two members by death—Mr. Henry Haynes and Mr. Richard Morgan.

The census of the Society at the end of the years 1877 and 1878 was as follows:—

	1877.	1878.
Honorary Members	10	10
Life Members	19	22
Annual Subscribers	140	138
	<hr/> 169	<hr/> 170

The Council have to announce the completion of the first volume of the Society's 'Transactions' and the commencement of the second, two parts of each having been published during the year. The publication of so much matter has added considerably to your expenditure, but the large number of members who reside at too great a distance from Watford to attend the meetings or derive any benefit from their membership besides the receipt of the 'Transactions,' seems to be a sufficient justification of the endeavour to give as complete a record of the proceedings of the Society as possible.

For the illustrations which have appeared in the first volume of the 'Transactions' the Society is in most cases indebted to the liberality of authors, Mr. Lobley having provided the woodcuts illustrating his lecture on the Cretaceous Rocks of England; Mr. Pryor the map of Hertfordshire showing his proposed botanical districts; and Mr. Harford the plate illustrating his lecture on the Polarisation of Light. To the Director of the Geological Survey of England, and the Council of the Geological Society of London, the Society also is indebted for the woodcuts illustrating the lecture by Professor Morris on the Physical Structure of the London Basin.

The following are the principal papers and lectures which have been read or delivered during the year 1878:—

- Jan. 11.—The Products of Hertfordshire; by the Rev. James C. Clutterbuck, M.A.
- Feb. 14.—Anniversary Address; by the President, Alfred T. Brett, M.D.
- March 14.—On British Butterflies; by the Rev. C. M. Perkins, M.A.
- April 11.—The Physical Characteristics of Minerals; by James U. Harford.
- May 9.—Meteorological Observations taken at Cassiobury House, from January to April, 1876; by the Right Honourable the Earl of Essex.
- . Meteorological Observations taken at Holly Bank, Watford, during the half-year ending 31st August, 1877; by John Hopkinson, F.L.S., F.M.S., etc., Hon. Sec.
- . Report on the Rainfall in Hertfordshire in 1877; by the Honorary Secretary.
- . Report on Phenological Observations in Hertfordshire in 1877; by the Honorary Secretary.
- . Notes on Economic Entomology; by Eleanor A. Ormerod, F.M.S.
- . Notes for Observations of Injurious Insects; by Eleanor A. Ormerod, F.M.S.
- June 13.—Notes on the May-fly; by Peter Hood, M.D.
- Oct. 10.—On the Origin and Present Distribution of the British Flora; by the Rev. George Henslow, M.A., F.L.S., F.G.S.
- Nov. 14.—On the Bulborne and Gade, with Notes on the Fish of the two Rivers; by John E. Littleboy.

Dec. 12.—Notes on the Botany of the Experimental Grass Plots at Rothamsted, Harpenden; by John J. Willis.

— . Notes on Birds Observed in 1878; by John E. Littleboy.

At the June and December meetings several short communications were also read, and microscopical and other objects of interest were exhibited.

The meteorological and phenological reports for 1877 will appear in the next part of the 'Transactions,' and the reports for 1878 will be presented at an early meeting. Several additional observers have forwarded their returns of the rainfall, and periodical natural phenomena are being observed at an increasing number of localities. To the two—Watford and Ware—from which observations were received in 1876, a third—Odsey—was added in 1877, and now observations are also taken at Harpenden and Redbourn.

As in the previous year one of the Field Meetings proposed had to be abandoned on account of the weather. It was intended to have visited Ashridge Park on the 12th of June, which, however, was unfortunately one of a continuous succession of wet days. Five Field Meetings took place, and each one was successful both as to its interesting nature and the attendance of members.

The following localities were visited :—

May 4.—Cassiobury Park, the Temple of Pan (Grove Woods), and Langleybury.

— 18.—Tyler's Hill, Chesham.

June 1.—St. Albans.

— 22.—Hertford and Ware.

July 3.—Moor Park.

The annual whole-day meeting was at Hertford and Ware, in conjunction with the Geologists' Association of London, when the able geological expositions of Professor Morris, and the cordial reception and hospitable entertainment of Dr. Gwyn Jeffreys, F.R.S., at Ware Priory, added greatly to the success and enjoyment of an otherwise most interesting field day.

For hospitality kindly afforded at the Field Meetings the Society is also indebted to Mr. Littleboy, Hunton Bridge; Mr. Willshin, St. Albans; and Lord Ebury, Moor Park. The parks and private grounds of the Earl of Clarendon, The Grove, and Mr. W. Jones Loyd, Langleybury, Watford; Mrs. Worley, New Barnes, St. Albans, and the Rev. F. D. Barclay Bevan, Amwellbury, Ware, have also been visited by the kind permission of their respective owners; and at Moor Park Lord Ebury threw open his house as well as his private grounds to the inspection of the members.

The donations to the Society's Library have been more numerous than during the preceding year. The donations of your Honorary Member, Professor F. V. Hayden, Director of the United States Geological and Geographical Survey of the Territories, still occupy the foremost place in number and value. The most important work of the Survey which has yet been issued, Professor Hayden's 'Geological and Geographical Atlas of Colorado,' an enduring monument to the ability and industry of the United States Surveyors and their chief, has lately been received. The number of societies

whose publications are received in exchange has considerably increased during the year, and some societies to whom your Secretary applied for an exchange in 1875, have now, after the lapse of three years, acknowledged the application by forwarding their proceedings and requesting exchange, a proof that your 'Transactions' are becoming widely known and appreciated.

During the year twenty volumes, principally consisting of the proceedings of societies received in exchange, have been bound, and there are now nearly 200 volumes in the library, showing an average accession, since the foundation of the Society, of fifty volumes a year. The arrangements which have been made, by which books may be exchanged between the hours of 3 and 4, and 7 and 9 p.m., any week-day, have already resulted in an increase in the number borrowed. The books are under the charge of the assistant-librarian of the Public Library, and a book-case has been provided for them by the Public Library Committee. Members who only visit the Library on the evening of the Society's meetings should exchange their books before the commencement of the meetings, as they can no longer be exchanged in the room in which the meetings are held.

To the microscopic object-cabinet, which will hold about 500 slides, the only donation as yet received consists of five slides from Lieut. Croft, F.L.S., to whom the thanks of the Society are also due for several donations to the library.

The financial condition of the Society is most satisfactory. With a greater expenditure than in any previous year, principally owing to the number and length of the papers communicated necessitating a considerable increase in the cost of printing the 'Transactions,' there is a balance of about £19 in favour of the Society; in addition to which two years' dividend on the Consols purchased in March, 1877, is due. In the purchase of Consols £100 were then expended, and £10 have since been placed on deposit at the London and County Bank, representing together the entire amount received for life compositions.

The Council have to announce the expiration of the term of office of your President, Dr. Brett. Since his election to the office Dr. Brett has presided at every evening meeting and has attended every meeting in the field. With an unusually extensive professional connexion, and other calls upon his time, he has never allowed any engagement to interfere with his attention to the affairs of the Society, the welfare of which he has been largely instrumental in promoting. The Council desire to express to him their thanks for the valuable services he has rendered to the Society.

The Council have also to express their thanks to the Committee of the Watford Public Library for the continuance of the accommodation hitherto afforded to the Society.

INCOME AND EXPENDITURE DURING THE YEAR ENDING 31ST DECEMBER, 1878.

[illegible]

The foregoing account was audited and found correct by us, and we find also that the amount of £10 is to credit of the Society on deposit at the London and County Bank, Watford, and that £100 has been invested in the purchase of £103 4s. 6d. Consols.

1st February, 1879.

E. M. CHATER, } *Auditors.*
J. W. WALKER, }

ORDINARY MEETING, 13TH MARCH, 1879.

J. GWYN JEFFREYS, Esq., LL.D., F.R.S., etc., President, in the Chair.

The President, in expressing his thanks for having been elected to the office at the preceding meeting, said that such societies as this did a great deal of good in the promotion of science, not so much by popularising it as by encouraging and enabling many of the members to become scientific workers. There is no one, he said, however gifted, who can undertake the investigation of every department of Natural History; each must study a special branch, and it is by the combination of advantages and opportunities that each of us in some degree possess that science is advanced.

Mr. Robert Thornton Andrews, Castle Street, Hertford; Mr. John Flower, 6, Fairfield Road, Croydon; Mr. Charles Edward Keyser, Merry Hill House, Bushey, and 47, Wilton Crescent, London, S.W.; and Mr. Herbert Wailes, Park Road, Watford, were elected Members of the Society.

The following lecture was delivered :—

"The Study of Geology." By J. Logan Lobley, F.G.S., F R.G.S.
(*Vide* p. 171.)

Dr. John Evans, F.R.S., said that he was happy to think that Geology had received due attention from the Members of the Society as compared with other branches of Natural History, and if anything were wanting to induce them to continue their interest in it the suggestions made by Mr. Lobley were likely to conduce to such an object. With regard to the three divisions of geologists pointed out by Mr. Lobley—the Catastrophists, the Uniformitarians, and the Evolutionists—he thought that although there appeared to be a broad distinction in relation to each of these views, and there was such a distinction when they were carried to the extreme, yet all thoughtful geologists would admit that there was truth in each of them. The strictest Uniformitarian would admit the possibility of cataclysms and convulsions more intense than those of modern times; all thoughtful Convulsionists would acknowledge that, given a certain amount of time, a number of comparatively minute convulsions would produce a large effect; and the more modern school of Evolutionists would admit that, whatever might be the result of continuous causes bringing in fresh forces, there might at the present day still be signs of the original forces in existence in a greater or less degree. The early history of geological thought which had been alluded to was one of extreme interest, even to those who were not geologists. The description of Pythagoras, as given by Ovid, was one of the most interesting of particular forms of thought that he was acquainted with. In the saying of Pythagoras: “I have seen that which was once sea become land, plains cut through by the action of running water, and mountains carried down to the sea,” they had the views of all modern geologists. He could fully endorse Mr. Lobley’s views as to the value of scientific terms, for the use of a strict terminology was one of the greatest aids to the advancement of science.

Remarks were also made by the President and Professor Attfield, and Mr. Lobley replied.

ORDINARY MEETING, 10th APRIL, 1879.

J. GWYN JEFFREYS, Esq., LL.D., F.R.S., etc., President, in the Chair.

Mr. George J. Attenburrow, Market Place, Hertford; Mr. William Robert Baker, Bayfordbury, Hertford; Mr. Herbert Bonsor, Great Cozens, Ware; Mr. Robert William Brett, Lea Side, Hertford; Mr. Thomas Stalkartt Carter, Farquhar Cottage, Bengoe; Mr. George Cooper, Fore Street, Hertford; the Rev. Lewis Deedes, M.A., Bramfield Rectory, Hertford; Mr. G. Reynolds Durrant, Old Cross, Hertford; Dr. Joseph Henry Gilbert, F.R.S., F.C.S., Harpenden; Mr. Henry Gilbertson, Mangrove House, Hertford; Mr. Frank Hall, Fore Street, Hertford; Mr. Augustus Hawks, Springfield, Hertford; Mr. H. C. Heard, Hailey Hall, Hertford; Mr. Joseph Hunt, High Street, Ware; Mrs. Gwyn Jeffreys, Ware Priory; Mr. Howel Jeffreys, F.R.A.S., 13, Campden House Road, Kensington, London, W.; Mr. S. Martin Leake, Marshalls, Ware; Mr. Henry Manser, The Lynch, Hoddesdon; Dr. William Ogle, M.A., 10, Gordon Street, Gordon Square, London, W.C.; Mr. Frederick W. Phillips, Maidenhead Street, Hertford; Mr. Isaac Robinson, The Wash, Hertford; Mr. Charles Tween, The Hermitage, Hertford; Mr. Frank Warner, The Cottage, Hoddesdon; Dr. William Warrener, Castle Street, Hertford; Mr. Charles Whitley, Jun., Lord Street, Hoddesdon; Mr. James B. Wohlmann, B.A., Fore Street, Hertford; and Dr. John Woodhouse, St. Andrew’s Street, Hertford, were elected Members of the Society.

The following paper was read:—

“Bees and Bee-keeping.” By the Rev. Herbert R. Peel, M.A.
(*Vide* p. 183.)

In the discussion which ensued, the President, Dr. Brett, Mr. Arthur Cottam, and Mr. Littleboy, took part.

Models of the hives, and other appliances, recommended for adoption by bee-keepers, were exhibited by Mr. Peel.

FIELD MEETING, 3RD MAY, 1879.

ABBOT'S LANGLEY AND LEAVESDEN.

Amongst other objections to the formation of a Natural History Society at Watford, when first proposed in 1875, it was urged that there was so little of interest in the neighbourhood, and indeed in Hertfordshire, that in a year or two every locality worth exploring would have been visited by the Society. All interest in the field meetings, it was predicted, would then cease, for the members would not care twice to go over the same ground. It is now the fifth year of the Society's existence, and this, like other adverse predictions, has so far proved groundless. Although one or two localities have been visited more than once, it has not yet been necessary to take the same route twice.

And not only is this the case, but how many localities have yet to be visited, even in the immediate neighbourhood of Watford. Aldenham, Radlett, and Shenley, in one direction; Chipperfield, Red Heath, and Chorley Wood, in another; and in a third, Leavesden, the Langleys, and Bedmont, may be mentioned as places in that small south-western corner of Hertfordshire in which Watford is situated, which have not been visited in the first four years of the existence of the Society.

On this occasion one of the directions above named was taken, and the members met at King's Langley station for a walk towards Bedmont, by Abbot's Langley, and through the Leavesden Woods to Watford.

Almost immediately on leaving the station the fields were taken towards Bedmont, and a considerable ascent was made from the alluvial plain forming the bottom of the valley of the Gade. The road from Abbot's Langley to Bedmont was reached at a spot where there is an outlier of the Lower Tertiaries,—one of those outliers which have been alluded to in reports of previous field meetings as affording evidence of the former extent of the London Tertiary beds over a very much larger area than at present, from which they have been removed by denudation.

At Abbot's Langley the principal object of interest was an old horse-chestnut tree, many of the branches of which have taken root and sprung up again, their size and vigour beyond the points at which they have rooted showing that they are deriving nourishment from these secondary roots. The area covered by this tree

and its branches was paced, and was found to be about 38 yards in diameter, or 120 in circumference. On the lawn at Langley House (Mrs. Hargreaves'), where this singular tree grows, some splendid cedars and other fine trees were also noticed.

From Abbot's Langley the route lay through the Leavesden Woods, where in ordinary seasons the ground would have been richly carpeted with wild flowers, but now scarcely any were to be seen; the long hard winter had made vegetation at least a month behindhand, and flowers which usually open in March or early in April were only just beginning to show themselves. The extreme lateness of the season may perhaps be best made evident by giving a list of the plants which *were* observed in flower in the course of the walk—

- Anemone nemorosa* (wood anemone).
- Ranunculus Ficaria* (pilewort or lesser celandine).
- Viola canina* (dog violet).
- V. arvensis* (field pansy).
- Oxalis Acetosella* (wood sorrel).
- Prunus spinosa* (blackthorn or sloe).
- P. Cerasus* (wild cherry).
- Potentilla Fragariastrum* (barren strawberry).
- Primula vulgaris* (primrose).
- P. veris* (cowslip).
- Veronica hederifolia* (ivy-leaved speedwell).
- Nepeta Glechoma* (ground ivy).
- Mercurialis perennis* (dog's Mercury).
- Lamium purpureum* (red dead-nettle).
- L. album* (white dead-nettle).

This list contains all that were noted at the time, and if to it we add the daisy and dandelion, it will most probably comprise all the plants which were actually seen in flower. Several were only just opening their flowers, and even primroses were only here and there to be seen, while in ordinary seasons the ground would have been richly carpeted with the flowers of the bluebell, primrose, and spurge.

ORDINARY MEETING, 13TH MAY, 1879.

ARTHUR COTTAM, Esq., F.R.A.S., Vice-President, in the Chair.

Mr. Russell G. Austin, C.E., Castle Street, Hertford; Mr. Vernon Austin, Castle Street, Hertford; Mr. William Henry Bowyer-Bowers, North Crescent, Hertford; Mr. Edward Rawson Parke Francis, The Nurseries, Hertford; Mr. Thomas Garratt, Hunsdon Lodge, Ware; Mr. Robert James Gray, Croxley House, Rickmansworth; Mr. John Gregory, Hoddesdon; Mr. Edward Manser, Dicker Mill, Hertford; Mr. Howard McMullen, St. Andrew's House, Hertford; Mr. Urban A. Smith, C.E., Castle Street, Hertford; Mr. Thomas Joseph Swarder, Wallfield, Hertford; Mr. Frederick Taylor, Fore Street, Hertford; Mr. Thomas Toovey, King's Langley; the Rev. Woolmore Wigram, M.A., St. Andrew's

Rectory, Hertford; and Mr. William H. Wilds, St. Andrew's Street, Hertford, were elected Members of the Society.

The following communications were read :—

1. "Reduction of Meteorological Observations." By William Marriott, F.M.S. Communicated by the Honorary Secretary. (*Vide* p. 197.)

2. "Meteorological Observations taken at Wansford House, Watford, during the Year 1878." By John Hopkinson, F.L.S., F.M.S., etc., Hon. Sec. (*Vide* p. 209.)

3. "Report on the Rainfall in Hertfordshire in 1878." By the Honorary Secretary. (*Vide* p. 223.)

4. "Report on Phenological Observations in Hertfordshire in 1878." By the Honorary Secretary. (*Vide* p. 229.)

5. Remarks on the Winter of 1878-79." By W. Marriott, F.M.S. Communicated by the Honorary Secretary. (*Vide* p. 237.)

FIELD MEETING, 17TH MAY, 1879.

WATFORD.

A large party, consisting of members of the Society and of the Geologists' Association of London, assembled at Bushey Station at 3 o'clock and proceeded at once to the Colne Valley Waterworks, near the station, where Mr. Philip Verini,* the Secretary of the Company, showed the party round the works, explaining the method of pumping and softening the water.

The main building was first entered, and here two horizontal steam-engines, each of 60-horse-power, were seen. One only is worked at a time, the other being kept in reserve for use when its companion requires cleaning or repairing, and beds are also ready to receive two others should they at any time be required.

Mr. Verini explained that the engine at work was pumping water from the well below, and at the same time drawing water from the softening tanks outside and forcing it into the reservoirs on Bushey Heath. The shaft below the engine he stated to have a lining four bricks thick for 70 feet in depth, to guard against the inflow of surface water, and water from the River Colne. Beyond this distance there was a boring for 140 feet, and the entire depth, from the floor of the engine-house, 25 feet above the mouth of the shaft, was therefore 235 feet.

A low circular building, called the slaking room, was next entered, and here were seen large cauldrons in which lime is crushed by a small hydraulic machine. From these are tubes through which the slaked lime passes into larger tanks where lime-water is made.

* It is with great regret I have to record the death of Mr. Verini, which occurred on the 18th of November. To his zeal and energy is mainly due the successful establishment and working of a company (of which he may be said to be the founder) which is conferring immense advantages on the district it supplies.

The method of working adopted in the slaking room having been pointed out by Mr. Verini, the rationale of the process was explained by Mr. John Evans, F.R.S. It was known, he said, as Clark's process, by which chalk was expelled, or deposited, from water by chalk. Caustic lime was mixed with water, and the lime-water thus formed being injected into the water pumped up from the well, which contained 16 or 17 grains to the gallon of bi-carbonate of lime, caused the greater part of this to combine with it so as to form a simple carbonate which being insoluble was quickly deposited at the bottom of the softening tanks, leaving the water with only 5 grains to the gallon of the bi-carbonate of lime.

The lime-tanks were then visited, one of which was in use and had at the bottom from three to four feet of lime from the slaking cauldrons. On valves being opened, soft water from the reservoir, at 300 feet higher level, forces itself through a series of holes in long tubes which are placed one foot apart at the bottom of the tank, and by passing through the slaked lime is converted into lime-water. This is then carried by a pipe into the softening tanks outside, which the members next visited.

Three of these tanks stand side by side. In the first the hard water from the well and the lime-water from the lime-tank were meeting, and, as Mr. Evans had before explained, lime was being deposited as a carbonate as the two currents—of lime-water and hard water—met, forming a re-deposited chalk. After this mixing process was stopped, the water, Mr. Verini said, soon cleared and was ready to be pumped into the reservoir on Bushey Heath.

In the second tank the water had become perfectly clear, and was of a most beautiful blue tint, from the reflexion of white light by the lime at the bottom and the absorption by refraction of the more refrangible rays of the spectrum, the red rays first disappearing, as seen in the green colour of the sea, and the yellow being next refracted away, leaving only the blue.

In the third tank the softened water had all been pumped up to the reservoir, and the deposit was being washed away with water from a hose, to be pumped up and stored away for sale.

Mr. Verini then showed the height to which water could be thrown in case of fire, setting some men to send water from a hose quite over the tower of the building, about 90 feet in height.

The store room, plumbing department, and smithy, were finally visited, and after a vote of thanks had been accorded to Mr. Verini, the members left the water-works for the adjoining chalk-pit, where, after a few fossils had been found, Mr. William Whitaker, F.G.S., of the Geological Survey of England, Honorary Member of the Society, gave an explanation of the section exposed.

Mr. Whitaker said that about fifteen years ago he gave a brief description of this section.* The chalk contained flints, and deposited on it very irregularly was a bed of clay, the lines of bedding

* 'The Geology of Parts of Middlesex, Hertfordshire, etc.' (Memoir on sheet 7 of the Geological Survey Map), p. 63.

of which were waved. The chalk was evidently cut out in a hollow before the clay was deposited, showing a very great interval of time between the deposition of the chalk and of the clay above. Elsewhere such hollows were nearly always caused by the sinking of the overlying beds through the dissolving away of the chalk. The clay could not be older than the boulder-drift, and he would call it glacial drift, though Dr. John Evans and other geologists believed it to be post-glacial. The mistake was often made of supposing all beds termed "glacial" to be considered by geologists as having been deposited by ice or in an arctic climate, but all that was meant by the term was that such beds were deposited *during* the glacial epoch, in which were intervals of warmer climate as well as cold periods. The bed now seen looked like some beds of brick-earth which elsewhere occurred under boulder-clay, and it might have been formed in some lake of no very great extent. On the top of this clay might be seen a bed of gravel, but he could not say whether it was a river-gravel or a glacial gravel. If it belonged to the glacial period, the beds of clay below must also be glacial. Glacial and post-glacial were, however, only relative terms, for glacial conditions lasted longer in the north of England than here.

On leaving the chalk-pit the road past Bushey Station was taken, and from an elevated position above Wiggenshall, affording a good view of the valley of the Colne and the hills on either side, Mr. Whitaker pointed out the connexion of the superficial features of the country with its geological structure. The range of hills on the edge of which we now stood was, he said, known as the Tertiary escarpment, the term "escarpment" meaning a ridge along which the beds were "cut off." These Tertiary beds once extended much farther over the county, and the escarpment was at one time beyond its present position, as shown by outliers of the London Clay and Reading Beds. The Colne had most probably determined the present line of the escarpment by cutting its way back, but further down it had cut through the beds. If we had been higher, we should have seen that the slope on the opposite side of the valley rose gently to a greater elevation than this, and we should find that this higher ground consisted of gravel flats of the same character as the one we had just walked over, the river having cut away the beds between.

The valley of the Colne was then crossed, and at the Colney Butts gravel-pits Mr. Whitaker stated that the gravels seen belonged to the glacial drift and were probably of marine formation, for in some places, as in Suffolk, marine fossils were found in sandy beds of similar age. The larger stones, perfectly rounded, must, he said, have come from the north; the pink quartzites were supposed to have come from the Lickey Hills; and the flint-pebbles had come from Tertiary beds, in which they had originally been deposited after the denudation of the chalk in which the flints were first formed—a vast quantity of chalk having been denuded to form such extensive gravel beds.

The Hagden Lane gravel-pits were next visited, and here the irregular surface of the chalk under the gravel was well seen. In continuation of his demonstrations of the geology of the neighbourhood, Mr. Whitaker stated that all gravels tended to form flats, very nearly level, wherever, as here, there was a large extent of gravel of any age. The gravels here were noteworthy as showing no lines of bedding. The very uneven surface of the chalk seemed to be due to its disintegration, by water, holding carbonic acid in solution, percolating through the gravel above. The gravel where not let down by this disintegration of the chalk was not more than 20 feet in thickness, being comparatively insignificant in section though occupying large areas.

Before leaving the pit a vote of thanks was accorded to Mr. Whitaker, and on the way to Watford Station the members of the Geologists' Association and a few members of the local Society had tea at Wansford House, the residence of the Honorary Secretary.

FIELD MEETING, 31ST MAY, 1879.

RICKMANSWORTH COMMON MOOR.

Rain was falling heavily, when, on the arrival of the half-past two train from Watford, the members assembled at Rickmansworth station, meeting there members of the Quekett Microscopical Club.

After some time had been spent in waiting for the rain to partially clear off, the station was left for the towing path at the side of the canal, by which the Common Moor was reached. Nets, dipping bottles, and other collecting appliances were then soon at work, and a few interesting microscopic objects were obtained, but too much rain had fallen on that and previous days, and the weather was too cold and cloudy, for any of the rarer Rotifera or Polyzoa, which are the most beautiful of the aquatic animals when viewed under the microscope, to be secured.

After several pools on the moor had been well tried with but little success, the American water-weed (*Anacharis alsinastrum*) growing in the running water was examined, and proved much more prolific in minute animal life than the water in the stagnant pools. Perhaps the most interesting object which was obtained in abundance was the caddis, the larvæ of at least two species of *Phrygania* being collected. The difference between the case of a species found in a running stream, and that of one found in comparatively still water, was remarked upon, the former being constructed chiefly of small stones or sand, and the latter of fragments of wood, straw, and other light substances.

When the collecting bottles were pretty well filled with objects for future examination under the microscope, the members of the two societies left the moor and returned to Watford by Cassio Bridge.

SPECIAL MEETING, 12TH JUNE, 1879.

J. GWYN JEFFREYS, ESQ., LL.D., F.R.S., President, in the Chair.

The President, having read the circular convening the meeting, stated that the following new rules were submitted to the Society by the Council.

I. The Society shall be called the HERTFORDSHIRE NATURAL HISTORY SOCIETY AND FIELD CLUB; its Head-quarters shall be at Watford; and its object shall be the investigation of the Meteorology, Geology, Botany, and Zoology of the County of Hertford, the publication of the results of such investigation, and the dissemination amongst its Members of information on Natural History and Microscopical Science.

II. The Society shall consist of Ordinary and Honorary Members, including Ladies; the number of Ordinary Members being unlimited, and the number of Honorary Members being limited to twenty.

III. The management of the Society shall be vested in a Council, consisting of a President, three Vice-Presidents for West Herts and three for East Herts, a Treasurer, two Honorary Secretaries (one for West and one for East Herts), a Librarian, a Curator, and twelve other Members, to be elected annually, by ballot, at the Anniversary Meeting, which shall be held at Watford in February in each year. The President shall not hold office for a longer term than two years, and in each year the senior Vice-President for each Division of the County, and the three senior Ordinary Members of the Council, shall not be eligible for re-election; but the Council shall have power to fill up, from these or other Members of the Society, any vacancy which may occur during the year.

IV. Not fewer than eight Ordinary Meetings of the Society shall be held in each year at such places and at such times as may be determined at the preceding Anniversary Meeting, but the Council shall have power to alter the day and hour of any Meeting, and at any time to appoint Bye-meetings for Microscopical study or other purposes; and during the summer months Field Meetings shall also be held at such times and places as the Council may direct.

V. Minutes shall be kept of the Ordinary and Anniversary Meetings of the Society, and of the meetings of the Council, and the minutes of each meeting shall be read as the first business of the next ensuing meeting of the same kind in the same Division of the County. At the Council Meetings, to be held at Watford only, five Members shall form a quorum.

VI. Members shall have the privilege of attending all the Anniversary, Ordinary, and Field Meetings of the Society, and of introducing one Visitor at any such meeting, and shall be entitled to receive a copy of all publications issued by the Society during their membership, and to the use of the Library in accordance with the library regulations.

VII. The Annual Subscription for Ordinary Members shall be Ten Shillings, payable immediately after their election, and afterwards becoming due in advance on the 1st of January in each year; but Members elected in the last two months in any year shall be exempt from the payment of subscription for that year. No Member shall be entitled to any of the privileges of the Society whose subscription is twelve months in arrear; and any Member whose subscription is two years in arrear may be excluded from the Society by the Council.

VIII. Any Ordinary Member may compound for his or her Annual Subscriptions by a payment of Five Pounds.

IX. All Ordinary Members shall pay an Entrance Fee of Ten Shillings, in addition to their first year's subscription or life composition, before they are entitled to any of the privileges of membership.

X. The Honorary Members shall be ladies or gentlemen of eminence in Natural Science, or who shall have done some special service to the Society, and whose usual place of residence is not in the County of Hertford, and they shall be elected only at the Anniversary Meetings by the Members upon the recommendation of the Council, not more than five to be elected in any one year.

XI. Every Candidate for admission shall be proposed by two or more Members, who shall sign a certificate in recommendation of such candidate, one of the proposers from personal knowledge. The certificate shall be read from the Chair at the Ordinary Meeting following its receipt by either of the Secretaries, and the candidate shall be balloted for at the next Ordinary Meeting at Watford, one black ball in six excluding.

XII. Members wishing to resign at the termination of any year are required to inform one of the Secretaries, in writing, of their intention to do so, on or before the 30th of November in that year.

XIII. The Accounts of the Society shall be made up to the 31st of December in each year, and audited by two Auditors appointed at the first ensuing Ordinary Meeting at Watford; and the Balance Sheet, together with a Report on the general progress of the Society during the preceding year, shall be submitted to the Anniversary Meeting in February.

XIV. All the funded and other property of the Society shall be vested in three or more Trustees, who shall be Life Members of the Society, appointed by the Council.

XV. The Society shall discourage the practice of removing rare plants from the localities of which they are characteristic, and of exterminating rare birds, fish, and other animals, and shall use its influence with landowners and others for the protection of the characteristic birds of the County: the rarer botanical specimens collected at the Field Meetings shall be chiefly such as can be gathered without disturbing the roots of the plants; and notes on the habits of birds shall be recorded instead of collecting specimens, either of the birds or of their eggs.

XVI. The Council may authorise the Society to undertake the investigation of any subject of a scientific nature relating to the County, and to publish the results of any such investigation.

XVII. No Rule shall be altered except by a majority of votes of the Members present at a Special Meeting at Watford called for that purpose. The Council may at any time, and shall upon a requisition signed by not less than twelve Members, convene a Special Meeting; and a printed notice stating the purpose for which the meeting is convened shall be sent to each Member not less than ten days before such meeting, at which no business shall be considered except that for which it was convened.

XVIII. A copy of these Rules shall be sent by one of the Secretaries to each Member upon election to membership of the Society.

A vote was then taken and the members present were unanimously in favour of the adoption of the Rules.

It was then decided that the Rules should date from the 1st of July, and that the four vacancies in the Council occasioned by Rule 3 should be left to be filled up at the next Anniversary Meeting.*

* One of these vacancies was provisionally filled up by the Council by the appointment of Mr. R. B. Croft, R.N., F.L.S., as Honorary Secretary *pro tem.* for East Herts.

ORDINARY MEETING, 12TH JUNE, 1879.

J. GWYN JEFFREYS, ESQ., LL.D., F.R.S., President, in the Chair.

Mr. Robert Barclay, High Leigh, Hoddesdon; Mr. Arthur Ernest Gibbs, Cumberland Road, St. Albans; Mr. William Odell, Castle Street, Hertford; and Mr. William Wickham, High Street, Ware, were elected Members of the Society.

Robert Etheridge, F.R.S., F.R.S.E., F.G.S., Palæontologist to the Geological Survey of Great Britain; and James Edward Harting, F.L.S., F.Z.S., Member of the British Ornithologists' Union, Editor of the 'Zoologist,' etc., were elected Honorary Members.

The following communications were read:—

1. "The Temperature of Thirty Summers and Thirty Winters at Hitchin." By William Lucas. (*Vide* p. 250.)

2. "The Recent Discovery of Silurian Rocks in Hertfordshire, and their Relation to the Water-bearing Strata of the London Basin." By John Hopkinson, F.L.S., F.G.S., etc., Hon. Sec. (*Vide* p. 241.)

Mr. Littleboy said that the question of water-supply was a very interesting and important one. The principal matter was whether these deep borings would rob the springs, and so lower the level of the water as to affect the supply of the rivers. He, however, understood that there was an unfailing supply of water in the Chalk. When Messrs. Meux's boring reached the Lower Chalk, was the supply great? He saw by Mr. Hopkinson's diagram that a thin layer of the Lower Greensand ran under the boring. When that was reached did the supply increase?

Mr. Hopkinson explained that in the Chalk there were large, more or less vertical, fissures full of water, and also underground rivers; but when they reached the Chalk Marl, which was a slightly argillaceous deposit, they missed these, and therefore there was no great accession of water on reaching the lowest beds of the Chalk. The effect of the borings was to lower the underground reservoirs. Instead of the water-level being horizontal, its surface was in the form of curves, the apex of each curve or system of curves being midway between the various outlets, towards which there was a gradual lowering of what had been termed the "plane of saturation," whether these outlets were natural ones as river-courses or springs at the outcrops of the water-bearing strata, or were artificially caused by borings or well-sinkings. The division of the Lower Greensand met with at Messrs. Meux's was a hard impervious rock, the permeable sands being absent; and therefore there was no increase in the supply of water.

3. "On a Boulder now in the Garden of the Royston Institute." By H. George Fordham, F.G.S. (*Vide* p. 249.)

4. Extract of a letter from the Rev. J. C. Clutterbuck, M.A., to Dr. Brett, giving notes on a section at the Oxhey Cutting, Watford, presented to the Society by him. (*Vide* p. 250.)

5. Extract of a letter from the Rev. R. H. Webb, M.A., to the Secretary, giving miscellaneous botanical notes. (*Vide* p. 250.)

6. A letter from Mr. Abel S. H. Smith, Watton, to the Secretary, on birds observed in his neighbourhood.*

* The information in this letter will be incorporated in Mr. Littleboy's "Notes on Birds observed in 1879."

7. Extract of a letter from Mr. H. George Fordham, F.G.S., to the Secretary, on the Partridge removing her eggs when in danger of being hatched.

Mr. Fordham, referring to Mr. Littleboy's account of a partridge removing her eggs,* and to the discussion which occurred on the subject,† quoted the following extract from Yarrell's 'British Birds,' 2nd edition, vol. ii, p. 372:—

"A gentleman living near Spilsby, in Lincolnshire, was one day riding over his farm and superintending his ploughmen, who were ploughing a piece of fallow land. He saw a partridge glide off her nest so near the foot of one of his plough-horses that he thought the eggs must be crushed; this, however, was not the case; but he found that the old bird was on the point of hatching, as several of the eggs were beginning to chip. He saw the old bird return to her nest the instant he left the spot. It was evident that the next round of the plough must bury the eggs and nest in the furrow. His surprise was great when, returning with the plough, he came to the spot, and saw the nest indeed, but the eggs and bird were gone. An idea struck him that she had removed her eggs; and he found her, before he left the field, sitting under the hedge upon twenty-one eggs, and she brought off nineteen birds. The round of ploughing had occupied about twenty minutes, in which time she, probably assisted by the cock bird, had removed the twenty-one eggs to a distance of about forty yards."

8. A letter from Mr. Robert Hanbury, Poles, Ware, to the Secretary, on the probable cause of the recent destruction of chestnut trees on his property.

A damaged branch of one of these trees being handed round, it was the general opinion that the injury was done by squirrels.

9. "On the Micro-Megascopus." By Arthur Cottam, F.R.A.S. (*Vide* p. 252.)

The President said that the Hydrographer at the Admiralty, who had just returned from Cyprus, had given him a bag of mud which had been brought up by an anchor from a depth of $4\frac{1}{2}$ fathoms in the harbour of Famagosta, which he had been surveying. Mr. Cottam being interested in the Diatomaceæ, he would hand the bag to him for examination, only asking him to give them notes on any discoveries he might make.

Numerous objects of interest were exhibited, including fossils from the Wenlock Shale recently discovered at the New River Company's boring at Ware, exhibited by Mr. Etheridge; fossils from the Gault and Wenlock Shale from the same boring, exhibited by Mr. Hopkinson in illustration of his paper; fossils from the Chalk at Watford, exhibited by Mr. Herbert Wailes; fossils from the London Clay at Bushey, and from gravel pits at Watford, exhibited by Dr. Brett; pottery (probably Roman) from ancient pottery works which have been discovered on the site of the Aldenham Grammar School, exhibited by Dr. Brett; a section at the Oxhey Cutting of the London and North-Western Railway, presented to the Society by the Rev. J. C. Clutterbuck; photographs of diatoms presented by Mr. J. Vincent Elsdon; and a badger shot in Long Spring Wood, exhibited by the Earl of Essex.

* 'Transactions,' Vol. II, pp. 29 and 35.

† *Ib.* p. xi.

FIELD MEETING, 14TH JUNE, 1879.

HARPENDEN AND ROTHAMSTED.

The object of this Field Meeting being to enable members of the Society to gain some knowledge of the general plan and chief results of the agricultural experiments which have for nearly forty-five years been carried on at Rothamsted, the party which assembled at Harpenden Station on the arrival, at three o'clock, of the train from St. Albans, proceeded at once to the "Lawes Testimonial Laboratory," on Harpenden Common, scarcely noticing the village, which is most beautifully situated, and of considerable interest from its historical associations. Most of the members forming this party, which numbered about thirty, had come by train from Watford to St. Albans, where they were joined by members from that neighbourhood; and on the way from Harpenden Station to the laboratory the number was augmented by members from the eastern side of the county, who had arrived by an earlier train.

At the laboratory the members were received by Dr. J. H. Gilbert, F.R.S., under whose direction the various experiments have been carried on since 1843; at first on a very small scale in a barn near, and since 1855 in this building, which was then presented by public subscription to Mr. John Bennet Lawes, LL.D., F.R.S., who had carried on experiments from about the year 1834, when the Rothamsted estate came into his possession.

Dr. Gilbert first gave a brief account of the origin, plan, and principal results of the experiments, both in the field and in the laboratory. In the field-experiments "some of the most important crops of rotation, each separately, year after year," have been grown, "for many years in succession on the same land, without manure, with farmyard manure, and with a great variety of chemical manures; the same description of manure being, as a rule, applied year after year on the same plot. Experiments on an actual course of rotation, with different manures, have also been made." At the laboratory samples of all the experimental crops are dried and burnt, and the composition of the ash determined, and weighed portions of the samples and of their ashes are preserved for future reference, there being about 25,000 bottles containing samples of various kinds, including annual products and soils, now in the museum, all of which were seen to be most carefully and fully labelled.

Amongst the experiments to which Dr. Gilbert drew attention may be mentioned the determination of the influence of different seasons on crops similarly treated, of the limit of capability of soils, and of the point of their exhaustion, samples of soils from the experimental plots, for every 9 inches, down to 54 inches in depth, being preserved. In treating of the experiments on the feeding of animals by certain foods, he stated that ash-analyses were made of the individual organs and parts, the nitrogenous constituents being determined in the various portions before being reduced to ash.

Turning then to some of the botanical results of the experiments, he explained the contents of a wall-case showing the principal results of the botanical separation of grasses and other meadow-plants in 1867, the twelfth year of experiments which still continue to be made on the mixed herbage of permanent grass land.*

Other rooms besides the chemical department and museum were visited, including the furnace, drying, balance, gas-analysis, calculating, and store rooms, and the members were then conducted by Dr. Gilbert through the "allotment gardens" to the experimental farm. The rain, percolation, and other gauges were first examined. There are two rain-gauges, one of the usual construction and five inches in diameter, and the other square, one-thousandth of an acre in area, and with a plate glass edge. The three gauges for the determination of the quantity and composition of the water percolating through the soil are also one-thousandth of an acre in area, and are respectively 20, 40, and 60 inches deep, the soil they contain, with its subsoil, being in its natural state of consolidation. In addition to these gauges to each of the differently manured plots of the permanent experimental wheat-field, there is a separate drain-pipe, so that the drainage-waters can from time to time be collected and analysed.

The private grounds adjoining the residence of Mr. Lawes in Rothamsted Park were then entered, and, after passing in front of the house, and thence through a fine avenue of lime trees, whose arching branches, rooting in the soil and then uprising in a dense tangle of young shoots, form most picturesque leafy corridors, the members arrived at a portion of Mr. Lawes' park about 8 acres in area, divided into 24 plots varying from one-eighth to half an acre each. Dr. Gilbert here explained the treatment each plot received and some of the most important results obtained.

The first plots examined showed that mixed alkalis alone, while they improve the character of the herbage, but little increase the quantity of produce; that nitrate of soda penetrates the soil and encourages the growth of deep-rooted plants which are not much affected by drought; and that it is impossible to get out in the produce any large amount of manure of any kind which has been put into the land, about two-thirds of the nitrogen supplied being unrecovered in the increase of crop when ammonia-salts are applied, and only about one-half when nitrate of soda is employed.

In a plot (No. 3) to which no manure had ever been applied, the average of four botanical separations, at intervals of five years each, gave 49 species of grasses and other plants, the order Leguminosæ contributing about 9 per cent.; in another (9), where ammonia salts had been added to mineral manure, the number of species was reduced to 29, there being only one leguminous plant; and in the next (10), to which, with the exception of potass, the same manure had been applied, there was not a single leguminous plant left,

* A paper on this subject, by Mr. J. J. Willis, has been communicated to the Society, and published in the 'Transactions,' Vol. II, p. 140.

the grasses having entirely pushed them out. In the adjoining plot (11) a great excess of ammonia salts added to the minerals had reduced the number of species from 49 when unmanured, to 18. At a plot (4) showing a number of so-called "fairy rings," Dr. Gilbert mentioned the curious fact that, although the fungi which grow on fairy rings are exceedingly rich in nitrogen, they grow on places where there is the least nitrogen supplied in manure; and at another (13) that with cut wheat-straw there was a more complicated herbage than without straw, and a much greater increase of produce than the amount of straw added would have led him to expect.

"Hoos Field," in which about $4\frac{1}{2}$ acres are devoted to experiments on the continuous growth of barley; "Broadbank Field," of about 13 acres, devoted to experiments on the continuous growth of wheat; and "Geescroft Field," in which about three-quarters of an acre are devoted to experiments on the growth of oats, were then visited in succession, Dr. Gilbert giving the principal results arrived at from the application of different manures. The various results obtained by sowing at different periods of the year, and by applying the manures in varying quantities according to the state of the weather or the difference in climate, were also dilated on by him. In one case he stated that after a heavy dressing of ammonia-salts a quantity of nitrates was found in the drainage waters, which would correspond to a loss of nearly 18lbs. of nitrogen per acre, provided an inch of rain had passed as drainage of that strength. On another occasion, after a heavy dressing of nitrate of soda, the quantity of nitrates found in the drainage water, reckoned in the same way, would be equivalent to a loss of about 13lbs. of nitrogen per acre. Thus in wet seasons, such as we have lately had, and might in our climate usually expect, it was the most economical for the agriculturist to apply his nitrogenous manures as a top-dressing to the crops in the spring, whilst the mineral manures, such as superphosphate of lime, etc., might be ploughed in with the seed, as phosphoric acid and potash were in a greater degree retained by the soil, and less liable to be washed away during wet winters.

Some other fields were then visited, from one of which a distant view of Flamsted Church tower was seen; and after hearing some particulars of the experiments on various leguminous and potato crops, to which these fields are appropriated, the members took leave of Dr. Gilbert, thanking him heartily for the amount of interesting and valuable information they had received from him.*

While a few then returned to Harpenden, the majority left the park in an opposite direction, pursuing their way by Hammond's End along bye-roads and across fields to Redbourn Bury, where they had been invited to tea by Mr. and Mrs. Arnold.

After a substantial and most acceptable repast, for which the

* Only a few of the points treated upon have been but briefly alluded to in this report.

thanks of the participants to their host and hostess were appropriately expressed by Mr. Littleboy, the river Ver, on which Redbourn Bury is situated, was followed as far as Bow Bridge, where the river is crossed by the Redbourn Road, which was then taken towards St. Albans. It was soon however left for the more pleasant fields; and, passing through what once were the gardens of cottages, now long untenanted, the river's side was again reached. A short stroll along its banks brought the party to Kingsbury, and after resting there awhile the Ver was again followed along the picturesque "Water Walk" to the St. Albans Station of the London and North-Western Railway.

FIELD MEETING, 25TH JUNE, 1879.

TWIN WATER, DIGSWELL, AND AYOT GREEN, WELWYN.

A central locality was this year chosen for the annual whole-day Field Meeting, in view of the extension and change of name of the Society, to enable members from all parts of the county to take part in it. Members of the Luton Natural History Society had also been invited to be present, so that, had the weather been favourable, a large attendance might fairly have been expected. There was, however, no cessation in the morning of the rain which had been falling almost continuously the previous day; indeed, with few exceptions, daily throughout the month; and owing doubtless to the prospect of a thoroughly wet day, but six members of the Luton Society and about three times that number of the Watford Society were present.

The locality was also chosen for the beauty and variety of its scenery. "To say that Digswell is the prettiest place in Hertfordshire," remarks our county historian, Mr. Cussans,* "may be considered a bold assertion, but it would indeed be difficult, throughout the whole of the county of Hertford, so renowned for the beauty of its scenery, to find another spot where wood and water, hill and plain, are more picturesquely combined;" and those members who, on this occasion, assembled at Welwyn station at half-past eleven, would doubtless, notwithstanding the almost complete realisation of the forebodings of the morning, fully endorse this statement.

Descending the hill into the beautiful valley of the Mimram, and then taking the road towards Hertford, the first place visited was an extensive gravel-pit excavated in the hill-side to the south of Tewin Water. The section here seen shows the presence of an outlier of the Woolwich and Reading Series (represented by sandy beds and mottled clay), reposing upon the Chalk, and overlaid by a gravel most probably of glacial origin.

At a short distance farther on the Hertford road a footpath across some fields soon brought the party to Tewin Water, remains of the

* 'History of Hertfordshire - Broadwater Hundred,' p. 251.—1877.

old Hertford road being noticed on the way. In a heavy shower of rain the pretty woodland walk by the side of the little river Mimram, affording every now and then in its windings a fresh glimpse of water, wood, and hill, at length disclosed to view the now more attractive sight of an empty barn, to which the party hastened, reflecting when under its welcome shelter how enjoyable might have been the walk just taken in fine sunny weather.

The rain partly ceasing, the barn was left, not, however, without some reluctance and hesitation, and a few minutes walk, in a gentle drizzle, brought the party out of Tewin Park and within sight of the fine viaduct, above a quarter of a mile long and one hundred feet high, with forty piers thirty feet apart, which carries the Great Northern Railway across the Mimram valley. Crossing the route taken on leaving the station, a circuit of about two miles having been made, and passing under this viaduct, Digswell Park was soon entered, and Digswell Church, dedicated to St. John the Evangelist, was visited. In it are some fine brasses in memory of the Perient family, and other objects of antiquarian interest, of which accounts may be found in our county histories. It was remarked that the floor of the church had evidently been considerably lowered, and that there had at one time been a fine oak ceiling, a portion of which had been left undisturbed in one of the side aisles.

On leaving the church an avenue of very fine Spanish chestnuts tempted the party into the grounds of the Manor House, and one of the trees was measured and found to have a circumference of five yards at the height of three feet from the ground.

The rain had now ceased for a time, and a pleasant walk through fields and woods and across an avenue of lime trees brought the party to the Rectory grounds. Openings here and there in the thickly-wooded grounds now strolled through, disclosed distant views of hilly woodland scenery, and the geological characters upon which this scenery depended were remarked upon. A halt was now called for luncheon, which had to be partaken of standing under shelter of the trees. Here some of the botanical finds of the morning were examined, and amongst them the tway blade, the bird's nest, the early purple, and the spotted orchis were produced.

Sherrards Park Wood, a good botanical hunting ground, was next strolled through, but being on the Boulder-clay, to which indeed its presence is due, it was difficult to find a path through it on which mud or water was not standing for some considerable depth, and impossible to wander off the path in search of its botanical treasures.

The single line of rails to Dunstable, which leaves the main line at the same spot as the Hertford branch, but in the opposite direction, passes through this wood in a deep cutting, which exposes a good section of the Reading beds reposing on the Chalk and capped by boulder-clay and pebble-gravel. A little farther on, the line passes almost through a brick-field, the next place to be visited. The route chosen was by Ayot Green, not the nearest way, but the Green is well worth visiting; cottages in picturesque groups skirt-

ing the triangular piece of common ground which gives the name of Ayot Green to this part of the parish of Ayot St. Peters, and fine old trees, apparently the remnants of a double avenue from which many have been lost by decay, giving the impression that the hamlet is an unmodernised relic of olden times, which the avenue of somewhat more recently planted oaks leading off the Green to Brocket Hall tends rather to confirm.

Leaving this avenue to the left, the right-hand road was taken, and just past the Ayot station the brick-field was entered. Here a continuation of the Sherrards Wood outlier of the Tertiary Series was seen, with the London Clay and its basement-bed distinctly shown above the Woolwich and Reading beds, and overlaid at the highest parts of the brickfield with a sandy pebble-gravel. The sections exposed in the various pits being searched for fossils by the geologists of the party, a number of sharks' teeth, and oyster and other shells, were found in the basement-bed of the London Clay; while the dyer's greenwood (*Genista tinctoria*) growing in profusion and in full bloom, and other plants which find their most congenial habitat in worked-out pits of sand and clay, attracted the attention of the botanists.

A few minutes' walk from the brick-kiln brought the party to The Fryth, the residence of Mr. C. W. Wilshere, who had invited the Society to visit him on the way back to Welwyn Station. Mr. Wilshere first showed the members round that portion of his extensive and beautiful grounds which immediately adjoins the house, pointing out the more remarkable of the particularly well-grown evergreen and forest trees which would alone make the grounds well worthy of a visit. From the terrace in front of the house a splendid view of the surrounding country was obtained, especially towards Hertford, across the valley of the Mimram and over a well-wooded hill, in which direction the spire of Bengeo Church formed a conspicuous object.

The house was then entered, and after tea and other refreshments had been partaken of, Mr. Wilshere showed the members his large and valuable antiquarian collection, consisting principally of sculptures and marbles from the Catacombs of Rome, the age and history of the more interesting of which he gave. Some time was thus spent while waiting for a heavy shower to clear off, and after thanking Mr. Wilshere for his kind thought in providing food for mind and body alike, The Fryth was left, and Welwyn Station reached by a more direct route than had been intended, there not being time to visit the chalk- and gravel-pits near Welwyn. There being a few minutes to spare at the station, the railway embankments near were visited, and a "pipe" of sand and clay in the chalk examined. This "pipe" is of large diameter, and it was noticed that through the gradual dissolution of the chalk, by water holding carbonic acid in solution, the sand and clay, which appeared to belong to the Reading beds, of which no other trace near was seen, had been so gently and gradually let down, that the position of a band of flints, passing across the pipe from the chalk on either side, had not been disturbed.

Before the party separated it was generally agreed that, notwithstanding the rain, a very agreeable and interesting day had been spent; and this having been mentioned as the last field meeting of the season, at the solicitation of a lady member, another was projected, the members of the Luton Society suggesting a visit to their neighbourhood.

FIELD MEETING, 12TH JULY, 1879.

CHILTERN GREEN, LUTON.

In response to an invitation from the Luton Antiquarian and Natural History Society, Members of the Hertfordshire Natural History Society assembled at Chiltern Green Station at a few minutes past three, and were there met by members of the Luton Society, each Society being represented by from fifteen to twenty members.

Permission to walk along the line having been received, the Dumhills railway-cuttings were first inspected. No sooner, however, was the station left, than rain began to fall, continuing to do so more or less heavily during the remainder of the day. The fine section of the Chalk exposed in these cuttings was therefore examined under rather adverse circumstances, the members necessarily geologising under the shelter of their umbrellas.

Mr. J. Saunders, of Luton, who has for many years made a study of the geology of the neighbourhood, here acted as guide, pointing out the chief characteristics of the different beds in the Chalk. The Upper Chalk, or chalk-with-flints, was first seen, the section traversed being a descending one from south-east to north-west, and that being the highest bed exposed. Next in succession was seen the chalk-rock, here about two feet in thickness, and having numerous characteristic fossils; while underlying it the Lower Chalk, or chalk-without-flints, was the lowest bed here exposed.

Before leaving the cutting Mr. Saunders gave a brief general account of the geology of the neighbourhood, pointing out that the hill on the opposite side of the valley in which Luton is situated presented an exactly similar and parallel section to this, showing that the valley was one of denudation, the strata with which it was at one time filled up having been removed by the denuding action of rain, rivers, or glaciers.

Turning off the railway-line into the fields a slight elevation was ascended on the right, and a path taken through a wood to the ruins of Someries Castle. Here Mr. William Austin read extracts from a paper, recently read by Mr. Thomas Hodgkinson before the Luton Society, giving a history of the Manor of Someries from the Norman Conquest to the eighteenth century, the Castle, which now forms a picturesque ruin, being stated to have been erected in the year 1448.

A chalk-pit was next visited, at one part of which numerous fissures filled with sand were noticed, some having a transverse

instead of the usual vertical direction. One of these "pipes," after descending perpendicularly from the surface for some distance, struck inwards or behind the exposed face of the pit, reappearing below a bed of flints which had undergone no change.

The members of the two societies then assembled at Chiltern Hall, where a considerable addition to their number was made, and in a large barn, which was admirably suited to the entertainment of the now numerous party, a substantial tea was provided by Alderman Cumberland.

At the conclusion of the repast, Mr. H. Brown, President of the Luton Society, proposed a vote of thanks to Mr. Cumberland for his kind hospitality. Referring to the beauty of the neighbourhood, Mr. Brown said that from near where they were now seated as fine views of Luton and the district as any with which he was acquainted might be obtained in fine weather; and, within a mile or two, Stevenage, Welwyn, and other distant parts of Hertfordshire could be seen. Dr. Brett, in seconding the vote of thanks on behalf of the Hertfordshire Society, said that this weather reminded him of the words of 'Punch': "Man is not wholly amphibious yet," but he did not know, if the rain continued, how long it might be before he became so.

The members then left in detached parties, some walking to Chiltern Green and others to Luton Station, and others again, including most of the ladies, taking advantage of conveyances which Mr. Cumberland kindly placed at their disposal.

TRANSACTIONS

OF THE

WATFORD NATURAL HISTORY SOCIETY.

VOL. II.

1.—FAMOUS TREES IN HERTFORDSHIRE.

By the Rev. CANON GEE, D.D.

[Read 18th October, 1877.]

IN preparing this paper for to-night I have considered that it was to be read before a society whose primary interest was Nature herself. I reminded myself that the scope of this society took in history only so far as it was "Natural History," or the history of Nature. I have therefore thought that it would be well to tell you at the outset the little I know of the nature of such trees as adorn our county. I have thought that, so, I should save my paper from being one long list or catalogue of remarkable trees, while we should be prepared to estimate aright the natural circumstances upon which the fame of those selected for honourable mention ought to rest—on their great size in height or girth, or on their extreme age. I shall only allow myself to eke out my meagre knowledge of natural objects, by combining some information as to the story of certain trees in Hertfordshire, which would give interest to trees otherwise unimportant.

I shall therefore begin my paper by an attempt to say something upon trees in general, and particularly upon those classes or kinds of trees from which our famous instances are to be taken. For, let me say before I go further, I purpose, if not from necessity, at least for convenience sake, to exclude all those ornamental trees which seem scarcely to have settled down amongst us or made themselves quite at home in Hertfordshire. I shall refrain from touching upon the Araucarias, Deodaras, and many varieties of the Pinus tribe, of which I know there are choice specimens in this immediate neighbourhood. I shall look for my famous trees among oaks, elms, beeches, limes, chestnuts, and ashes. I am quite aware that even then there are cedars, sycamores, birches, maples, and others, that are left out in the cold by such an arrangement. This only shows that I have greedily helped myself to too wide a subject. But against this charge I would plead, in extenuation, that I have really opened the way for closer observers to follow me. I think some

might well take a night for the full examination of one particular sort of tree, and make a monograph of the beech or lime. To this more exact and full treatment my sketchy paper may serve as a profitable introduction.

I would break ground with a remark upon the claim of certain trees to be indigenous among us—to be, really, English trees. This consideration will bring before us at once the oak, which of right must be placed in the forefront of our studies to-night. It has been said that the oak has more claim to be a truly English tree than most. A token of this may be seen in the readiness with which the oak seeds among us and grows from seed. Many will tell you that the oak grows best, naturally, from its oak-corn or acorn. This distinction may be strongly seen when you contrast with the oak the common elm. The elm does not ripen, nor, I believe, often form, a seed in this country. It certainly is propagated most commonly by slips. Of course the cedar is not indigenous. The first cedars planted in this country may be identified, at least by tradition. "There are two cedars now standing," says Mr. Johns, "in a garden at Chelsea, and said by Lord Holland to have been planted in 1683 by his ancestor, Sir Stephen Fox." The lime or linden seems German by its association with *Unter den Linden*, or French, with its connexions with *Fontainebleau*, or Swiss, from the old custom of planting a lime tree wherever they won a victory from their oppressors. The beech is expressly said by Cæsar not to have been found in Britain, and its Welsh name "*Fawydd*" is taken to be an adaptation of the Latin *Fagus*. Indeed these, our old Roman masters, are thought to have naturalised here the chestnut, lime, sycamore, box, and laurel. But they do not claim to have introduced the oak, and we may safely declare the oak to have been English in pre-natural-historic times. No one can doubt that it thrives well with us and takes a giant's grip of our soil. It is said that even Americans, accustomed to the giant trees of their forests, yet find an unmatched stateliness and grace in the English oaks.* Our climate suits it. No one ever heard of an oak as being affected by the severity of a winter, whatever that severity may be. We may say of the oak that its gnarled and knotty trunk is engendered by the rigours of our Northern skies. So Kingsley says of ourselves—

"'Tis the hard grey weather
Breeds the Englishman."

So very long has the oak been among us that we are scarcely aware that he seems to have had an elder half-brother; at least, that much of the oldest oak timber in this country is not of the same kind as that now in use. What we call oak timber now is the wood of the *Quercus pedunculata*. This has its fruit stalked and its leaves sessile. The other oak, the *Quercus sessiliflora*, has its fruit sessile and its leaves stalked. This latter is the oak which furnished timber to some of our oldest buildings—notably to St. Alban's Abbey and to

* "English Parks have trees as fine and effective as any of ours."—Mrs. Stowe, in '*Sunny Memories*.'

Westminster Hall. The old wood is so far unlike our modern notion of oak timber, particularly in the absence or indistinctness of the silver grain, that it was long considered to have been chestnut. Now, the distinction which I have just laid down seems to be recognised and to entitle this old timber to be called oak. I may mention here that at the hospital of St. Cross, near Winchester, I myself saw oak of a very singular, dark grain. The brother who "showed me round" told me that it was considered a specialty, and that a visitor had offered much money to be allowed to take it out and replace it. He added that the peculiar grain was commonly attributed to the way in which the wood was cut. The extreme length of each plank was only five feet and it might all have been cut crossways.

A natural question arises at once with regard to the oak, viz., as to its extreme age. I mean as to the age which it would attain if left to itself, or as to the age of some patriarch of our own acquaintance. I do not see how this can be ascertained except by documents, and documents will not go back as far as we desire. Granted that an oak marks its growth by natural indications, yet when growth ceases, these indications stop. Not to be irreverent, an old oak is like an old horse with the teeth-marks "gone out of his mouth" as the ostler would express it. I cannot tell upon what grounds the Saley Forest Oak in Northamptonshire is so confidently pronounced to be 1,500 years old. We can make no experiments you know for ourselves in this direction, unless you would repeat the failure of the good old lady, who, having heard that a tortoise would live 100 years, bought a young specimen that she might judge for herself.* I conclude that the only approach to investigation would be to notice carefully the growth of an oak still growing, and to calculate in what time, proportionally, an old oak would have attained its girth, and then to allow a proportionate time for decay. Of course this growth would vary much from relation to soil and aspect; still something may be done in this way. Our Lord Lieutenant, a lover of trees and an observer long before I took up the subject, has most kindly entered into my endeavours to interest you to-night. He has given me his experience with regard to trees at Gorhambury. He summarises his conclusions as being, that an oak increases in girth † half-an-inch per annum, and a cedar two inches in the same time. But in the memoranda which he kindly furnished there is a difference between the oaks of which he gave me the measurements. I do not know what experience the poet Dryden had of trees. He most likely gives us the general opinion of his own day in laying down poetically that an oak's duration is 900 years:

"Three centuries he grows, and three he stays
Supreme in state, and in three more decays."

* This illustration is said to be as old as the time of Hierocles and first applied to the crow—*longæva cornix*.

† Throughout this paper the term "girth" is taken in the popular sense of *circumference*.

Perhaps this may not be an inappropriate place to give you the best version I know of the common prognostication of weather founded on the earlier appearance of the leaves of the oak or of the ash. The prognostication seems little worth, the earlier leafage having relation to what has been, rather than to what will be. The deep-rooted oak thrives best in a dry season, and the shallower ash in rainy springtimes. The verse is as follows:—

“If the oak opens before the ash,
 'Twill be warm and dry, with good wheat to thrash;
 But if ash leaves open before the oak,
 There'll be cold, and of rain too great a soak.
 If the oak and the ash open nearly together,
 Look out for a summer of changeable weather.” *

I string together a few remarks on other trees generally. I have spoken of elms as foreigners, but I admit that they were naturalised in the times of the Heptarchy. Like the old family of Coplestone,

“They were at hame
 When the Conqueror came.”

They have given Saxon names to many English villages, as Elmbridge, Elmham, Elmsthorpe, Elmstead, Elmstone, and Elmwell. The elm's failing is to become hollow at 80 years of age, and at that time its arms and roots both become brittle. It has a special beetle to itself called the elm-beetle (*Scolytus destructor*). Its great value is for articles subjected to alternate wet and dry conditions, *e.g.* for pumps, troughs, conduits, water-wheels, and water-gates. If the elm be originally an immigrant, he has since become an emigrant also. There is this much to be said in support of the idea that the wych elm does ripen a seed; so it may be thought to have been the earlier or more recognised elm. Perhaps it was from his own personal connexion with this country that Philip the Second of Spain planted the avenues of Madrid with English elms. Learned men differ as to the origin of the name wych elm. There are three derivations proposed. 1. From the Saxon word “wich,” a village or town, as Sandwich, Middlewich, etc. This would make the wych elm to be “the village elm.” 2. From the word wych meaning a box or press, such having been made originally of this wood. Our modern word hutch would be a corruption of this, and wych (spelt at first *hwæcce*) is applied in old writings to the ark of the testimony, as also to provision boxes in daily use. We have, in old writings, “wyches for the cheeses.” 3. From a superstitious notion that witches frequented this tree, dancing round it or dwelling under it. So far as I can distinguish the original orthography, it seems in favour of the second meaning, which would derive the word from wych, a chest or box.

The beech tree peculiarly claims the neighbouring county of Buckingham as its own. It gives its name to the county, as well as

* I have found this and much other tree lore in an article on Ornamental Planting in the ‘Quarterly Review’ for July 1876 (No. 283). I have made very free use of the information there contained; sometimes adopting the very expressions.

to the indispensable thing, *book*, and, perhaps also, to the valuable thing *bacon*. In this county of Hertford it has more variety in its way of growth than any other tree which I have observed.* We see the difference not far from here. The beech close to the Langleybury Parsonage, which seemingly has always stood out by itself, is a model of what a fully developed tree may become. It scarcely seems to have lost a twig from the first. It was carefully ironed in Mr. Whittingstall's time. The hardest thing you can say of it is that it is too perfect to be picturesque. An artist would choose a tree more twisted and deflected. At Ashridge you may see the contrary form of elegance which a beech will take, when crowded in its nursery, and, as the expression is, "etiolated" by too close proximity of its neighbours. Then it will run up straight as an arrow and upright as a dart, or "a rod of steel," as my correspondent describes such beeches. He who does not go, before this very October is out, to see the King and Queen beeches at Ashridge, does not deserve to sit under trees or biographers of trees. These royal trees, girthing only 11 feet or 11 feet 6 inches—the lady is the stouter—run up, I am assured, 85 feet before throwing a branch. If you journey thither, mind that you go straight to the trunk and stand close up to the very stem. Then look at all the glory of the olive-grey, smooth, clean shaft.

Limes are known by their employment by all carvers, and notably by that prince of carvers, Grinling Gibbons, in the production of his choice works. It is said that the wood is not only smooth-grained and beautiful in its enduring colour of pale yellow or almost straw or creamy white, but that it is also insect proof. I would inform any who may have had a lime blown down in the recent gale, or who, as myself, have been compelled to cut down a lime, that it should not be sold cheap. It is worth about 3s. per cubic foot, as it lies, and is employed to make the keys of pianos, for which its little tendency to warp makes it valuable.†

Of the ash I will only say that Gilpin, having pronounced the oak to be the Hercules of woods, calls the ash the Venus. I myself always reserve the title of Lady of the Woods for the birch. Gardeners, it seems, in some places, time the planting out of their bedding stuff by the appearance of the ash leaf, and remove this tender material when the leaves fall. It is peculiarly tough wood, and the stoutest oar, tool shaft, or lance handle is always made of ash.‡ But it is considered a dull tree, coming out late and going off soon, and without any bright colour on its rather thin foliage.

* There are three styles of the beech. Your Ashridge instance, a rod of steel. Then, the apple-tree topped Surrey style, with its trunk painted in three colours—white, grey, and dark green. These great patches show no doubt the unkindliness of the stunted plant, but dear are they to the landscape painter. Then, lastly, there is our noble Dean Forest style of giants with as much height as your Ashridge specimens, but with massive boles and perfect heads. Such trees amply justify Spenser's epithet—the "warlike beech."—*Correspondent*.

† Of course only such parts of the wood as are perfectly free from knots are available for this delicate purpose. I am informed on good authority that the cost when ready for keys is about one shilling "per foot in the inch."

‡ "The ash for nothing ill."—*Spenser*.

Chestnut, whether horse or Spanish, should always be spelt with a "t" in the middle, in honour of its derivation from *chataigne* (French) and *castanea* (Latin), both of which words come from the city of Castana in Pontus, whence chestnuts first came into Europe; as cherries came from a neighbouring town, Cerasus, now Kerasaun. I particularly admire, in large Spanish chestnut trees, as at Ashridge, the twist, as of a rifle barrel, which the bark takes, giving the effect of a spiral column, and making the tree look larger than it really is. I was surprised to find one tree that I measured to be only fourteen feet in circumference. And there is at Abbot's Langley a singular instance of the horse chestnut taking fresh root with its branches and springing out again, as does the banyan, thicker than where it touches the ground. The road having been raised formerly under the large chestnut on the lawn of Langley House, this process may clearly be traced where the earth has been lifted up until the branches touched the soil. They have taken root and sprung up in renewed vigour. The interest of this tree is so great that it throws literally into the shade the cedars on the lawn, one of which is $16\frac{1}{2}$ feet round.

I might leave out the larch as being a member of the excluded Fir tribe. I would like to say a few words of this tree as being a tender nursing mother or nursing father to the oak. In the only forest of which I know anything—the Forest of Dean—they prepare for planting, or I think I should say, sowing oaks, by planting larches. These spring up soon and form a screen and shelter for the more valuable seedlings. By the time that the oak can stand alone the larch is valuable as a pole, and is then removed to the planter's immediate profit. So is fulfilled the saying that "Larch will buy you a horse when oak will not buy you a saddle." Still, as Sir Walter Scott says, "Plant trees, good trees," for, as he puts into the mouth of one of his characters, I think Dumbiedikes, "They'll aye be creeping while ye are sleeping."

Now I am at liberty to notice individual trees in Hertfordshire, famous for their own grandeur, or for their story. Even in the first division of natural grandeur, I desire to make a subdivision. There are trees famous for their girth, implying age and generally involving decay. Some of our most venerable friends are mere shells. There are others which stand erect in stalwart strength and are solid and massive trees. Comparisons are odious; but I think we ought to do justice to the really vigorous and more natural trees, for the greater girth will always be found in those which have been polled or pollarded. I do not want you to look at a tree as do some of my simpler neighbours, in whose minds at once rises the consideration of what it would fetch when down. "I'd be bound to say, sir, that there are four loads of timber in that tree. Why, I recollect when a water wheel at such a mill wanted a new axle-pin master got £50 for such a hoak." No! I would deprecate so commercial a view of the glories of our county. I would rather ask you to look at a grand oak as Smeaton, the engineer of the existing Eddystone Lighthouse, studied an oak when the third

edifice had to be placed on that storm-beaten rock. Then it is said it struck him that if he could imitate the proportions of a tree which weathers every blast, he might hope that his work would stand. He figured to himself a model tree with a real waist, which would encourage the waves to curl over and discharge themselves innocuously. On those lines he built, and the continuance of his erection to this day shows that his labour was not in vain. Well, we will distinguish the old knotted and gnarled patriarchs from these their worthy congeners as best we may. But, applying ourselves to take only the girth of a tree, we are in some indistinctness, how to measure, or how to compare measurements. At what height shall we take the girth? Shall we be bound to take it at a certain arbitrary height, though not the most favourable to the particular tree? I think not. I understand that we are to get the greatest girth that can fairly be measured, after clearing the root knobs or earth knots. This, for our own comparison, should be taken as



FIG. 1.—The Lion Oak in Hatfield Park.

nearly as possible at the same height in all trees. I approve of Lord Verulam's rule of thumb. He always measures a tree at the height of his own waistcoat pocket, he standing on the best side of the tree for a ground level. Do what you will, trees will not oblige you by coming into a competition upon terms of exact equality. I have found two trees of which the girth of one was the greater, but it was a hollow sinuous girth, while the less tree met the tape evenly and closely on all its sides, and on that account seemed really the finer tree. Then, what shall we lay down as our unit of fame? What size shall make a tree famous? I distrust some of the extreme measurements that are given. I have sceptical doubts as to that tree in Hatfield Park, which, according to the 'Quarterly Review,' measures 48 feet in circumference. If it be the oak called the Lion Oak (Fig. 1), that tree I have measured myself and find the circumference to be 31 feet. I have never been able to measure more than one other tree all the way round that

measured more than 30 feet in circumference. That was the yew in Crowhurst Churchyard in Surrey. It has a door in the side, and several persons go in, and squeezing tight, declare that they are able to sit round it inside. I would suggest that we take 20 feet circumference as our starting-point, and that we make it our business to be on bowing terms with all trees in West Herts of that girth. You need not be afraid of an inconveniently large acquaintance, while you will not be overwhelmed with everybody else's favourite tree.

The largest tree that I know, and seemingly the oldest, in Hertfordshire, is the Spanish chestnut tree at Little Wymondley, near Baldock. It is now the wreck of a wreck. There is not half of its circumference standing, though a print at High Elms, of the year 1790, shows the tree as much more nearly perfect. An original girth of 42 feet is claimed for this chestnut, and possibly may have been attained; but if so, the tree must have projected on the fallen side, and would not be in anything like a circle with what is left. It is still a grand old tree, and one is ready to believe that it was standing at the time of the Conquest. There is no mention of it however, in the Domesday Book of the parish. Wymondley, being then king's land, stands in that book first of all in Hertfordshire. No! nothing of this tree, though the account relates of the other Wymondley that there is wood in this parish that would make fences, and pasturage for so many sheep. Here I may notice the value of our own researches, in that the size of particular trees seems singularly ignored in all county histories. I have found no Domesday notice, as I have said once, of particular trees. Looking through the indices of Clutterbuck and of Chauncy, I have found but one solitary tree specified in each. That in Chauncy is a walnut tree at Codicote, now gone. It is stated by deposition before a Justice of the Peace, that this tree covered 74 poles of ground and took a lad of fifteen years, eight of his fathoms, to reach round the trunk. My schoolmaster tells me that this area of 74 poles, supposing it to be a circle, represents an outstretch or radius of 80 feet from the centre of the stem.

Next to the trees already mentioned, the largest girth that I know is of a pollard oak in Moor Park, that measures 25 feet, and another near it measures 23 feet. There is also in this park a prostrate lime mentioned in the Rev. C. A. Johns' book as among the largest in England. It must have been a fine tree, though, like the Codicote tree, its size lay in the space it covered, rather than in its height or girth. Close behind it, and in the avenue or row skirting the park, is another lime in full vigour, girthing 23 feet. This is a beautiful tree. There are two beech trees in Cassiobury, near the Swiss Cottage, both of which reach my standard of fame. Lord Verulam writes me word that the Kennel Oak, at Gorhambury, measures 23 feet. The Queen Oak measures 20 feet, and he has a lime which measures 22 feet. He gives also as just below my standard (being 19 feet 10½ inches) the Kiss Oak, the origin of which title, his lordship thinks, is that the oak was cased or fenced.

By-the-bye, you perhaps may care to know that the many Gospel Oaks in the country had their names from the fact that, in perambulating the parishes, the Gospel for Rogation Day was formerly read when the beaters of the bounds reached that particular oak.

I shall speak of the tall oaks presently. I believe that in what I have said of the girth of oaks, I have said enough to begin a list to which my hearers may add for themselves, and I hope that they will give me the benefit of their possessed or acquired knowledge. I know how many trees in our own neighbourhood I have omitted, and how little justice I have done to Cassiobury, at our very door. Now, with regard to height, you may say, "It is all very well to measure girth, but how are you going to measure height? Who is to tell us whether a tree is 130 or 140 feet high?" I can give you two rules of thumb, which will, at least, assist calculation. This is one. Supposing your tall friend to stand out well in the open; set by the side of him a stick of ascertained height, say of 6 feet. Watch at the proper hour the length of shadow cast, both by your six-foot rod and by the tree. Then calculate in proportion the height of the shadows cast; *e.g.*, If the tree's shadow be 12 times the length, take its height as 72 feet. Or, take three laths, join two of them at a right angle, and let each lath containing the angle be of the same size. Then unite the equal sides with a third, subtending the angle. Now hold this level and opposite the tree. Walk away until your eye looks up the third and long side to the summit of the tree. You may now consider yourself to be standing at the apex of an enlarged triangle, of which the ground line is one side and the erect tree another. You measure the ground line,* and in so doing you measure the height, for it equals the perpendicular which you thus get. *Q.E.D.* I know very little about these things, and am indebted to my naval brother-in-law for the scheme, which, I am told, is used by sappers and others in military engineering. We tried our laths upon our house, church, and other ascertained heights, and found them correct. We then tried our triangle upon the tallest tree that I know about here—the spruce in the Cassiobury Woodwalks, and found the height to be some 135 feet. Timber trees are not very high, if Brown, in 'The Forester,' be correct in giving the following as the mean average height of the trees:—

Oak	45 feet.	Poplar	48 feet.
Ash	38 "	Fir	57 "
Beech	45 "	Chestnut	44 "
Birch.....	47 "	Syeamore	37 "
Elm	44 "	Yew	16 "
Lime	44 "		

I have reserved as an example of a tall tree the Panshanger Oak, which is now, I regret to say, "in a very poor way," and not long for its present lofty position. The ground appears to be

* Of course I am aware that this is not strictly speaking the *ground* line, but a line say five feet above the ground. The ground line reaches at least a good step farther back.

undermined beneath it. The whole height, as given me by a timber dealer's measurement, is 73 feet; but I distrust his measuring to the very top of what he would call waste. Indeed, another measurement gives twice this, 140 feet, as the extreme height, but that again has not my confidence. The branches, he states, stretch southwards 60 feet, and northwards 35 feet, making a shelter of some 100 feet in diameter. All accounts agree that it increased rapidly in the later years of its growth. According to Clutterbuck, between 1719 and 1805 it added 480 cubic feet of timber to its contents. A certain Mr. Barker, timber measurer, of Bishop's Stortford, says that this growth had not ceased in 1795; further that in 15 years from 1780 it had increased only $1\frac{1}{2}$ inches in circumference. The value of the tree, as containing 17 loads of timber at £15 per load, with top and bark, the valuer, Mr. Ellis, in 1811, places at £255.

There is another, and a nearer tree, an oak of this same character, which I wish to commend to you. It is the Grimston Oak at Oxhey. This tree, insufficiently known, stands a few yards from Oxhey Chapel, at the fence of Mr. Blackwell's farmhouse. It is 17 feet in circumference, and 24 feet in "length," which means, I suppose, the length of its branches. I should have taken it to be about that number of feet to the branches. It is a very well grown tree, very dear to the Gorhambury family, who, I am informed, have commended it to the care of the new proprietor of the estate. It was planted by James, second Viscount Grimston, who died in 1773, and who had married the daughter of John Askell Bucknall, Esq., the heiress of Oxhey. The tradition of the family, Lord Verulam tells me, is that his great-grandfather planted this tree with his own hands. Supposing him to have planted the tree some 20 years before his death—his eldest son was 26 years old at his death—you get a fair idea what a well-grown oak would become in 120 years' time.

I would like to mention an ash in my parish, not because of its extreme size, but because I do not happen to know a finer, and because it is a very well grown tree. It stands at the Hyde-lane Farm, in Abbot's Langley parish, and is 12 feet round. It has a fine, clear, straight stem, appreciated only by standing directly underneath the tree. It once, I am told, had a narrow escape from the usual fate of trees,—becoming the axis of a water-wheel. It then, many years ago, said the old top-sawyer, my informant, contained three loads of timber.

I have now to speak of those trees which, without reference to height or girth, are famous from historical associations. Foremost among these stands out Queen Elizabeth's Oak at Hatfield. Half-way down the avenue leading from the house towards Hertford, and surrounded by a fence, and in not vigorous health, or of very remarkable bulk, stands this tree, which I myself years ago visited with reverence, and brought away a leaf (I would not have broken off a branch for the world), to be preserved among such mementoes of our history. I very nearly took off my hat to it. On the

morning or afternoon of November 17th, 1558, for poor Mary died between 4 and 5 a.m., Elizabeth was sitting under this tree when a deputation arrived from the Council to apprise her of her sister's demise and to offer her their homage. She fell on her knees, and exclaimed in Latin, "*A Domino factum est istud et est mirabile in oculis nostris.*" "It is the Lord's doing, and it is marvellous in our eyes." (Ps. cxviii.) And this motto she took as the stamp upon all her gold plate.* It must not be supposed, however, that this formal intimation was a surprise to Elizabeth. My informant (Miss Strickland) says that Queen Mary had already sent her the Crown jewels and her dying request in behalf of her servants, and that Throckmorton, her confidential agent, had prematurely informed her of her sister's death even before the event took place. Elizabeth, fearing some snare, had answered his news with a requirement that, if true, the black enamelled ring should be sent her which Mary was known to wear night and day. Afterwards—44 years later—when pressed to name her successor, she declared that she would not send him such visitors as came to see her at Hatfield, numbers having for some days been passing and repassing on that "Great Northern Road." Most likely the burst of pious thankfulness was genuine, and was the expression of relief at the termination of a season of suspense, the tension of which "'Twixt Axe and Crown" had become unbearable.



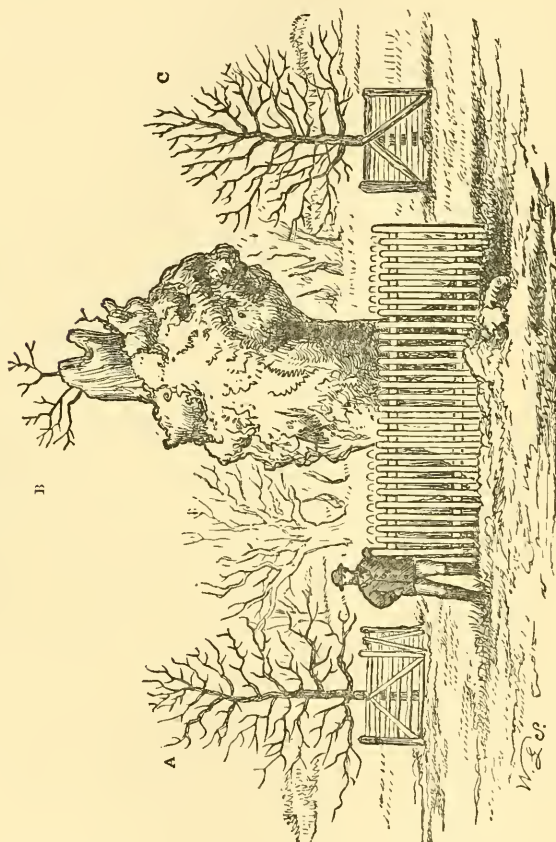
FIG. 2.—Oak in Hatfield Park, measuring 33 feet in circumference.

We shall return presently to Hatfield, but let me say here that there is a wonderful group of hoary ancients near the keeper's lodge, not far from the trees of the Queens. They are hollow and decaying but of considerable size. From this group the oak represented in Fig. 2 has been selected for illustration. I could not hear of any in the park larger than these.

* This motto had previously been on Mary's coins.

Noting the late season of the year, Nov. 17th, at which this hardy Queen had seemingly sat out of doors, I hope that it will not be impertinent of me to correct here a mistake of which I have certainly heard a young lady guilty with regard to another famous oak tree. "Ah!" said an accomplished fair one to me on a chilly May morning, when the spring was very backward, "King Charles could hardly have been hidden in the oak on the 29th of *this* May."

FIG. 3.—*Royal Oaks in Hatfield Park.*



A. Oak planted by the Queen.

B. Queen Elizabeth's Oak.

C. Oak planted by the Prince Consort.

* * * This and the preceding illustrations are reproduced from the 'Gardener's Chronicle' by the kind permission of the Editor, Dr. Maxwell T. Masters, F.R.S.

No, my dear miss, nor was he so hidden on the 29th of any May. The Battle of Worcester, as the Battle of Dunbar—Cromwell's two crowning mercies—was fought on Sept. 3rd, his dying day, and said to be also his birthday until Mr. Carlyle and others produced the entry showing that he was born and christened in St. John's parish, Huntingdon, in April, 1599. The entry into London took place on Charles's own birthday, May 29th, and then, in memory of the

Boscobel transaction, the oak leaves were worn.* Of this Boscobel tree, let me say (before I leave the subject) a descendant is said to exist in Gadebridge Park, Sir A. Cooper's; but my inquiries after the truth of the tradition have been unsuccessful. But Hatfield Park has later trees of Royal fame. On the occasion of a visit paid by Her present Majesty and the Prince Consort to the late Marquis of Salisbury, they were pleased to plant trees in the immediate neighbourhood of Queen Elizabeth's Oak, and a triad of royally famous trees may thus be seen at once in this specially favoured spot (Fig. 3).

I have not quite done with Queen Elizabeth and her connexion with Hertfordshire and Hertfordshire trees. There is another domain in Hertfordshire or its borders, only less closely connected with this royal lady than is Hatfield. Look into the index to Miss Strickland's 'Biographies,' and you will find some half-dozen references to Ashridge. I have heard that the house at Ashridge stands partly in one county and partly in another. The parish church, Little Gaddesden, where the Bridgewater family lie buried, is in Hertfordshire. Of the ashes which gave name to that ridge only one remains, as far as I could observe on my visit the other day. Under this tree, or one of its fellows, we may think the Princess Elizabeth also sat, and so very likely used to sit the "bons hommes" of Ashridge—the hermit priests who formerly owned that beautiful spot, and who lie in the church which the house itself includes.

It will be next in chronological order to notice the Oak Wood in Gorhambury. This is a wood at the back of the house, specially so called. When Lord Chancellor Bacon was in financial difficulties, it was suggested to him that he should cut down this particular wood. "What! man," said he, "would you have me pluck out my own feathers?" And so the trees escaped, and some, I believe, are now standing. The circumstance is told in most Lives of Lord Bacon as if it applied to oaks generally, and they are spelt with a little "o." Lord Verulam informs me that the tale hangs round the particular Oak Wood, as distinct from others, Brook Wood, etc. And Barnard, in his 'Drawings from Nature,' states, I do not know on what authority, that the first Oriental planes introduced into England were planted at Gorhambury by the great Lord Bacon.

I now come to Moor Park to notice two traditions with regard to trees there. Moor Park was once owned by Cardinal Wolsey, perhaps in virtue of his connexion with St. Albans as *Abbot in commendam*. There is a tree which, Lord Ebury tells me, still goes by the name of the Cardinal's Oak. He described to me its exact situation. Lord Ebury thinks that it had its name rather from the fact of the Cardinal having sat under it than having planted it. It is too old, according to Dryden's lines, to have had its beginnings only some 350 years ago. The other Moor Park tradition is as to the beheading of certain trees there. The estate undoubtedly be-

* Is there any authority for supposing that the Oak had previously been the badge of the clan Stuart? After 1745 many a soldier was punished for putting an oak leaf in his cap on May 29.

longed to the Duchess of Buccleugh, who is introduced into Scott's 'Lay of the Last Minstrel.' This was Anne, Duchess of Buccleugh and Monmouth, representative of the ancient Lords of Buccleugh, and widow of James, Duke of Monmouth, who was beheaded in 1685. Of her Sir Walter says:—

“She had known adversity,
Though born in such a high degree,
In pride of power, in beauty's bloom,
Had wept o'er Monmouth's bloody tomb.”

Lay, Canto 1, Introduction.

And, says the tradition, on her husband's execution she beheaded sundry of the forest oaks in the Park. This may have been done from morbid sentimentality; or from a wish to save them, as some suppose, from confiscation; or rather, perhaps, from a somewhat spiteful wish to prevent their ever being used as timber in that navy of which her husband's cruel uncle, James the Second, was so proud. Whatever the motive (which could scarcely be excusable, much less praiseworthy), the tradition holds good as to the fact. And I understood Lord Ebury to say that it was with reference to this special legend, that Froude, the historian, encouraged him to believe that wherever tradition is clear and strongly-rooted, and consistent with common-sense, there is truth in the main fact asserted. I think, therefore, we may continue to believe that these Moor Park pollards had the historical origin attributed to them.

There is another kind of tradition which has made some trees famous, or at least notorious. It respects those trees which grow out of tombstones or from the crevices of vaults. Certainly some trees do seem to choose such spots. I imagine that a seed having found its way there and expanded in peace, was at first encouraged from the sentiment that it was pretty, and afterwards that it afforded a pleasant canopy to the tomb. Not until too late was it found that the intruder was master of the situation. With relentless force it crushed the monument into which it had intruded, and altogether took possession of the memorial.

Just such an intruding sycamore stands in Aldenham Churchyard, and has made small account of stone slabs and of iron railings. But a case, better known, is in Tewin Churchyard, in the tomb of Lady Anne Grimston, through which have grown several stems of more than one kind of tree. Our forefathers, who scarcely seem to have been wiser than ourselves, fitted on a startling legend to these trees. It is that Lady Anne was in lifetime an unbeliever, and that she arranged with some survivors (as sceptical as herself) that if there were another world a tree should grow out of her vault to announce the fact. Lord Verulam has given me leave to discuss the tale with you. He feels strong in the evidence there is of the fair profession of this poor slandered lady, and has given me extracts from her house-books. She certainly conformed to the requirements of religion and lived in all such ordinances blameless. Clearly she went to her parish church, and in her carefully kept account books we find that she put up her horses, as do her successors at Gorham-

bury; only, 200 years ago, she seems to have done it somewhat more cheaply, *e.g.*

March, 1682.—For setting up on Sunday (twice)	8 <i>d.</i>
For setting up the Horses at Church (Fryday)	6 <i>d.</i>
April 15.—Setting up the Horses when Dr. Bell preached	4 <i>d.</i>
Setting up the Horses when my lady stayed (for H. C. ?) at Whitehall	1 <i>s.</i> 0 <i>d.</i>
July, 1683.—Setting up the Coach Horses and Black Nags, morning and afternoon, at Michls., on Sunday	1 <i>s.</i> 8 <i>d.</i>

And so on. It is rather hard, after a life of such regular profession as this, to be accounted an unbeliever 200 years subsequently to one's own time, upon account of the capricious growth of a tree. It is not every one whose friends could produce so much *post-mortem* evidence of having lived, at least, as well as other people.

I would say of trees historically, as well as naturally, famous, that I shall be very grateful if enabled to enlarge my catalogue by the kind information of my hearers. I leave all individuals now, and would wish to be permitted to wind up my paper with two remarks upon trees generally. I would try to enlist on your parts a feeling of Conservative preference for the older kinds of trees. I think that our old English trees have got such a character of their own, and give such a character to the landscape, that there is a loss when their monopoly of the fields is largely invaded. I grudge to see some of the foreigners prominently introduced into what I venture to call "*our parks*." I know a park a few miles hence where the *Araucaria imbricata* is pushing its hard, cast-iron, puzzle-monkey branches into the air. The *Deodara* and *Wellingtonia* (or, as it is now called, *Sequoia*) are following up the invasion; and I can imagine how these colonial gentry will look down upon oaks and elms in the days of our grandchildren. I am aware that this objection is narrow, and a like narrow-mindedness, 200 years ago, would have kept out cedars. Happily, a passing expression of complaint has little effect either way. I would only press my stricture so far as to urge that large planters should not introduce these strangers in too large a proportion, and so alter the character of the English forest scenery. On a very small scale I try to keep this in mind in planting our churchyard, though I must confess to two *Sequoias* which are already becoming too large for us. I like to think of God's Acre in England as being English, and not New Zealand or Californian, ground.

The one remaining reflection which I would ask to be permitted to make is as to the moral impression, or even religious effect upon us, produced by considering the longevity and slow growth and firm hold of the earth taken by these sons of the soil. It must strike us that there is here a singular contrast to the tree-planter's own limited continuance on this same scene. A man plants an oak. He never hopes to sit under it. When his threescore and ten years shall be run out, the tree will be not half-way towards maturity. The most he can hope for is, as in the case of the Oxhey Oak, that his great-grandson, though not the possessor of

the tree, may keep up the remembrance of this good work. I myself have a weak hope that some Vicar of Abbot's Langley (next but three, say, after me) may speak of my lime avenue in our churchyard as they speak at Welwyn of the limes planted by the writer of the 'Night Thoughts,' and say of mine, "These were planted in old Mr. Gee's time;" but the trees themselves everywhere, to be noteworthy, are so old that we must rather say that in our time and turn, "We belong to them, than that they belong to us." How many generations of old and young have told their tale of joy and sorrow under a Kiss Oak of 20 feet circumference. How must the old tree smile to see a new generation coming to it with the old, old story. I am myself inclined to think of such a tree as the old monk thought of Leonardo's great fresco in the refectory, opposite to which so many generations came, and ate and drank, and went away, and came no more. "Surely," said he, "the figures on the wall are the realities, we in the hall are the shadows." But no, surely this suggests a notion, or encourages and strengthens a belief, that the duration of man takes place somewhere else. If 1000 years be the continuance in the Maker's eyes of vegetable life, then the highest form of the higher, or the animal life, cannot be on an average less than one-twentieth of that term. There must be, as the Psalm says, "a planting in the House of the Lord of those who shall flourish for ever in the Court of our God."

I check myself in an honest tendency to improve the occasion in the direction of my own special vocation. I will end with a verse from him, from whom you would scarcely expect a very earnest aspiration of immortality, and yet it says all I want to say. It is said that Lord Byron wrote the following epitaph for a tomb in Harrow Churchyard. The allusion will explain itself.

"Under these green trees pointing to the skies,
The planter of them, Isaac Greentree, lies.
The time will come when these green trees shall fall,
And Isaac Greentree rise above them all."

2.—THE BIRDS OF OUR DISTRICT.

By JOHN E. LITTLEBOY.

[Read 8th November, 1877.]

It is certainly one of the advantages of our Society that it includes within its scope so large a variety of subjects, many of them perfectly distinct in themselves and yet all more or less connected by a common tie. At our last meeting we heard a most interesting paper on "Famous Trees in Hertfordshire"; this evening I am about to lay before you a few particulars respecting birds that have been observed more especially in the neighbourhood of Hunton Bridge and King's Langley, but it is my intention cursorily to allude to other districts within our county. For much of the information respecting birds in the King's Langley and Chipperfield districts I am indebted to Mr. Thomas Toovey; and I have also to acknowledge the assistance of several other gentlemen who have been good enough to send me interesting particulars. And here I wish to say that I do not pretend to approach this subject from its scientific side. I confess to being a warm admirer of birds; for years past I have endeavoured to observe their habits, and it is in the capacity of an observer, and in that alone, that I venture to address you.

I have prepared a classified list, which I shall append to this paper, of all the birds which I can record, with any degree of certainty, as having been observed in the neighbourhood referred to. They number ninety-two. I have also added the names of a few others reported to have been shot by the gamekeeper at Munden, and which are still preserved in the vestibule of Munden House. With this list before me as a guide, I will now briefly allude to a few particulars that I have been able to collect respecting some of the birds mentioned, and I will commence with the Hawk tribe.

It is a curious instance of retributive destiny that hawks, or falcons as they were formerly called, are now ruthlessly destroyed on account of the exercise of those very faculties and instincts which in days gone by constituted them, beyond all others, the most coveted and fashionable of birds. Of hawks we have only two varieties, the kestrel and the sparrow-hawk; the former is the most abundant, and I may mention that a brood of young kestrels was hatched during last season in Mr. Blackwell's rookery at Chipperfield. Kestrels are almost invariably shot by gamekeepers, as belonging to a dangerous family. The old proverb "*noscitur a sociis*" is not always to be depended on, and in this instance I believe the practice to be a mistake. It is true that kestrels will occasionally victimise a wounded partridge, but their food consists for the most part of field-mice, grasshoppers, beetles, and earth-worms, and I believe that they but rarely attack any bird larger than a lark.

The sparrow-hawk is a far more courageous and daring fellow than the kestrel. He appears to be naturally pugnacious, and will attack birds much larger than himself. His favourite food is said

to be leverets, young rabbits, partridges, thrushes, larks, etc., but he does not despise, by way of variety, a few young chickens, and I have seen him hovering, in a very suspicious manner, over our own poultry. I am informed by a friend that he noticed a large wood-pigeon in the clutches of a sparrow-hawk, and that, although the pigeon was still warm, its head and a portion of its neck had been eaten off.

Of owls we have only two or three varieties. The common barn owl is to be found in almost all districts. Wherever an old barn or an accessible roof can be made available for shelter, he is pretty certain to become a constant visitor. One of our servants was desperately frightened, one moonlight evening, by suddenly discovering a barn owl, which she persisted in calling a "death-bird," demurely sitting on the wall that divides our garden. Barn owls formerly frequented a hole in one of the trees at the Little Elms, Watford. The tree, as many will remember, was broken off by the wind. Two dead birds were found in the stump that remains, and it is believed that the rest of the family perished with their adopted home. Concerning the brown or tawny owl I have only one memorandum; I find that thirteen of these birds were driven at one time from Mr. Blackwell's pigeon-house at Chipperfield. An owl considerably smaller than either of the species I have mentioned has been frequently observed in the chestnut trees at Gaddesden Hoo. It has a weird unearthly screech, but up to the present time it has not been possible to identify it. I have also to record that a specimen of the short-eared owl (*Asio accipitrinus*), a species that is only an occasional autumnal visitor in the southern counties, was recently shot at South End, near Redbourn. My hearers will remember that the owl has played a rather prominent part in mythological story. It was the favourite bird of Minerva, and many of the silver coins struck at Athens have the representation of an owl on the reverse side, as an emblem of Pallas Athena, the tutelary goddess of that city.

Among Carnivorous birds the red-backed shrike, or butcher-bird, must not be omitted. During the past summer I have seen an unusual number of these birds; indeed, I have rarely driven any distance from home without meeting with one or more of them. The male bird is especially handsome and can hardly fail to be observed. Like so many among the interesting group in natural history that we have under consideration, the red-backed shrike possesses a peculiar adaptability to the exigencies of its nature. Its strong bill is abruptly hooked at the end, and the notch is so deep as to form a small tooth more or less prominent on each side. By this conformation the bird is enabled to take a firm grasp of its food and to tear it in pieces. The claws also are remarkably strong and sharp. Many curious facts are recorded respecting the ways and doings of the red-backed shrike. Its food consists principally of mice, small birds, frogs, lizards, grasshoppers, beetles, and cockchafers. It is stated that after catching and killing its victim, it will impale it on a thorn and thus leave it, as a tit-bit, to be consumed at leisure, or

as the caprice of appetite may suggest. I have frequently heard it affirmed that the well-known line of Dr. Watts,

“Birds in their little nests agree,”

must be regarded as a poetical fiction with scarcely the shadow of a foundation. This can hardly be said respecting the red-backed shrike; the attachment of the parent pair to each other and to their young is singularly striking. It is stated by Morris,* that “a male red-backed shrike having been caught in a garden by a cat, the gardener, who saw the occurrence, succeeded in rescuing it from the animal in time to save its life. It was put into a cage and placed in a sitting-room close by, in which were several persons, but notwithstanding this, the female, its companion, came in at the window, settled on the cage, and was secured by one of the party without attempting to fly away.” It is a summer bird, and leaves us early in the autumn.

Next upon my list is the spotted flycatcher. This charming little summer visitor is an universal favourite; it abounds in all our gardens and may be seen along the edge of every copse and almost every hedge-row. It is easily distinguished, even at a considerable distance, by its short and jerky flight. It is fond of sitting on a railing or iron fence, and from its selected perch it darts rapidly off in search of its insect prey, quivers for a few seconds in the air, and then returns to the exact spot formerly occupied. It is a sociable and confiding little bird, and appears to covet the guardianship of man. I am informed that a pair of flycatchers built their nest in an acacia tree in the boys’ playground at the Berkhamstead Grammar School. Is it possible to conceive a greater act of confidence than this? I am sorry to say that it was misplaced; although the nest remained undiscovered until four eggs had been deposited, the temptation was too strong to be resisted, and the eggs quickly disappeared.

On two occasions we have been favoured with a visit from the dipper. This bird, abundant in Wales and Scotland, is extremely scarce throughout the Midland Counties. In form it strikingly resembles the wren, but in size it is about on an equality with the missel thrush. It is readily recognised by its creamy white breast, and when once seen cannot be mistaken. It is very distinct, and differs in its habits from all its fellows. It is as much a water-fowl as the dabchick, but its feet are not webbed, and it indulges in a low melodious song—an accomplishment not possessed by any other water-fowl. It is said by some authorities that the dipper deliberately walks under the water along the bottom of the stream, but it is maintained by others that he swims through the water, using his wings as paddles. Neither of our visitors was sufficiently polite to favour us with a performance, and we know not which theory is the true one.

Of the thrushes and the blackbird I need say but little. We have four varieties of thrushes—the missel thrush, the song thrush, the redwing, and the fieldfare. The missel and song thrush are dis-

* History of British Birds, vol. i. p. 236.

tributed throughout our district in great abundance. Every one must have listened to the melodious notes of these gifted birds. They love to frequent a garden, and will generally select the top-most branch of a shrub or tree from which to pour forth their plaintive melody. They sing much later in the evening than most of the other birds. "Long after the varied music of the rest has ceased, the song of the thrush yet remains;" and many a time have we listened to it, in our garden at Hunton Bridge, until the shades of evening have darkened into night, and we have felt almost spell-bound to the spot. The eggs of the thrush are often to be found as early as the middle of March. They are prolific birds, often rearing two, and sometimes three broods during the season. The young fledgelings are voraciously fond of fruit, and woe to the unfortunate strawberry-bed that happens to lie within their reach. At Hunton Bridge we are compelled to net all our strawberries or scarcely one would ripen; and even when this is done, the young throstles will frequently push their way under the netting, and in this manner we have often caught many of them. The thrush is a determined enemy of every description of snail; he will rap them against a stone with his beak until the shell is broken, and the snail is then instantly demolished. Quantities of broken snail shells may often be noticed on a gravel walk as the result of these operations. The redwing and the fieldfare are both migratory. They reach us from their northern homes about the end of October or the middle of November. The redwing is the smallest of its class; in appearance it much resembles the song thrush, but can be distinguished from it by the red tinge on a portion of its wings. The fieldfare may be regarded as the special representative of winter. "The hoar visage of winter," to use the metaphor of De Quincey, would hardly be complete without him; we look for these birds almost as to a certainty as we drive along the hard and frosty roads on a cold December morning, and presently we desery a considerable number of them, swooping across, right in front of us, till they alight, possibly, upon the snow-covered furrows of an adjoining field. The name of the blackbird is a household word in almost every family; his magnificent black plumage, his rapid flight, and his clear, bell-like note are familiar to all of us. He begins to build early in February, and, like the young throstles, his progeny are devout believers in the excellency of strawberries and other early fruit.

The hedge-sparrow and the robin belong to the same family. The former of these appears to be the victim of a misnomer. It unquestionably belongs to the Warblers, and possesses but few characteristics in common with the plebeian sparrow. The hedge-sparrow is an unobtrusive confiding little bird; its nest, containing four or five bright blue eggs, may generally be found by about the middle of March, and its cheerful, musical song, "soft and gentle like itself," may be heard from almost every hedge-row, and on almost every day throughout the year. We have many more attractive and brilliant songsters than the hedge-sparrow, but we have few more constant attendants on our daily walks, and we know

of none that we should more decidedly regret to banish from the precincts of our garden. And now I must confess that I stand confronted with a difficulty. How shall I adequately describe the redbreast?—the robin redbreast of our childhood, that we have all fed with crumbs so many, many times, on a winter's morning, from the parlour window, and that is so intimately associated with our very earliest recollections. How strangely do memories of an olden time,

“The tender grace of a day that is past,”

linger around its name! But I must try to strip him of adventitious associations, and to describe him as he really is. I am afraid that, in some respects, I cannot speak of him quite so highly as I could wish. He is a selfish, quarrelsome little fellow, somewhat of a glutton, and supposed to be singularly deficient in parental affection. But he possesses his better characteristics also; of no other bird can it be said that he positively courts the companionship of man. Wherever you may be, whether in the garden or field, whether amidst the inmost recesses of the forest, or on the wide, open common, seat yourself but for a few minutes on the stump of a fallen tree, and there, hopping unconcernedly about, within a yard of your elbow, you will infallibly observe a robin. Robins appear to be almost ubiquitous; their number must be legion, and yet I will venture to say that no one has ever seen a flock of them together; they are generally to be observed either singly or in pairs, and rarely indeed is more than a single pair visible at the same time. This peculiarity has been variously accounted for. It is said that they are so quarrelsome that, like certain near relations, they find it most satisfactory to live at a considerable distance from each other. Then, again, I have seen it maintained that the robin wages a war of extermination against all intruders, that the young birds are especially severe on their older and weaker relatives, that in this manner large numbers are constantly destroyed, and the isolation of the survivors maintained. I do not pretend to solve the mystery; I tell the tale as it is told to me, and here I must leave it. The robin will frequently build in most grotesque and unlikely places; he has been known to select the coat sleeve of a garden scarecrow, and even an old kettle in a blacksmith's shop.

Now a few words about the remainder of the Warblers, and under this head the following species may be classed:—The redstart, the chats, the wheatear, the sedge, reed, and garden warblers; the chiff-chaff, the blackcap, the whitethroats, the gold-crest, the willow-wren, and the nightingale. The redstart, the stonechat, and the whinchat generally frequent open waste lands and commons. The nests of these birds have been found on both Berkhamstead and Chipperfield Commons, and that of the stonechat on King's Langley Common. The redstart occasionally selects a more questionable locality in which to build. I am informed by one of our members, Mr. Ransom, of Hitchin, that for three years consecutively a redstart has built and reared its young in the open roof of his

chemical laboratory, immediately over the evaporating pans, where the nest would, during the day, be constantly surrounded with steam largely charged with vegetable fumes, among which I expect that the *Atropa Belladonna* and *Ilyoscyamus niger* would bear a principal part. The wheatear I have never personally been able to identify within the limits of our district, but it has been noticed by a careful observer in the low meadows between Hunton Bridge and King's Langley. The sedge warbler and the chiff-chaff are both migratory, the chiff-chaff being one of our earliest spring arrivals. And how welcome are these spring visitors as they crowd in upon us. Winter with its cold winds and biting frosts is past and gone—a new world opens before us—like the birds and the insects that surround us, we feel its genial influence, and our hearts can hardly fail to join in the chorus of universal praise that we listen to on every side.

“The ants, the bees, the swallows reappear,
 Fresh leaves and flowers deck the dead season's bier;
 The amorous birds now pair in every brake,
 And build their mossy homes in field and brake;
 And the green lizard and the spotted snake,
 Like unimprisoned flames, out of their trance awake.”

The nest of the chiff-chaff is generally built about a foot from the ground, and is very similar to the wren's. The reed warbler and the garden warbler are by no means common, but these birds, together with the whitethroats, the willow-wren, and the two species last noticed, are so extremely difficult to distinguish, the one from the other, that mistakes as to their identity are more than possible. A nest of the reed warbler attached to three reeds, and only about eighteen inches above the water, was taken last year at the Tring Reservoir. The nests are elegantly built of slender blades of grass, interwoven with reed tops, dry duckweed, and the spongy substance that abounds in many of the marsh ditches; they are unusually deep, and sway to and fro with the wind, occasionally almost dipping into the water. The garden warbler has been observed at King's Langley during the past season. Respecting whitethroats, I find that I have no memorandum, and I will simply state that the lesser whitethroat is by far the more uncommon of the two. Next in rotation is the blackcap, and here we again have a noticeable bird. He ranks high upon our list of songsters, is a splendid mimic, and his note may occasionally be mistaken for that of the nightingale; he is extremely careful of his young, and, as far as we know, he is the only small bird which, like the partridge, will feign a broken wing or an injured leg, in order the better to decoy an observer from his nest. The blackcap is excessively fond of raspberries. As soon as the young birds can fly, they attack our raspberry canes, almost in swarms. It is difficult to frighten them away, and when endeavouring to do so I have frequently watched them desert one clump only to besiege another.

The gold-crest, or as it is more generally styled, the golden-crested wren, is the smallest of our English birds, and I have seen it stated that five of them will not exceed in weight one ounce. They are

charming little creatures, and few sights are prettier than to watch them actively at work, fluttering about and searching for their food. Their nests are beautifully built, of globular shape, with a small opening at the top. We have generally several in the garden at Hunton Bridge, and on one occasion we were delighted to espy six or eight tiny little birdies, but just fledged, all huddled together on the branch of a spruce fir. We watched them with the greatest interest, and presently discovered that the two parent birds were constantly flying to and fro laden with insect food for their little nestlings. At King's Langley a pair of gold-crests have this year built in a tree close to the back door of a gentleman's residence. The willow-wren or hay-bird is also a constant summer visitor to our garden. It builds a domed nest, and is a remarkably hard sitter. I have seen it stated that even the nest itself may be removed without disturbing the bird.

I will complete the Warblers by briefly noticing the nightingale. Its superlative powers have been described so frequently that I shall not attempt a repetition. I presume there is hardly a single person in this room who has not again and again listened with delight to its glorious notes. The nightingale generally reaches this district between the 10th and the 21st of April. Its song appears to increase both in volume and power until the middle of May, but as soon as the young are hatched it either ceases altogether or subsides into a guttural croak. It is quite a mistake to suppose that the nightingale is shy; while in the act of singing he appears to be perfectly absorbed in his wondrous efforts and quite indifferent to the approach of listeners. A few years ago a member of my family succeeded in inducing three of them to come for food whenever they were called, and before we lost them in the autumn they would fearlessly approach almost close to her feet.

Next upon my list are the Tits. They are a very amusing family, and possess striking characteristics. We can claim five among their number as pretty constant visitors:—The great tit, the coal tit, the blue tit, the marsh tit, and the long-tailed tit. The first four have many qualities in common; they are extremely grotesque in their movements and will repay careful observation. It has been our practice at Hunton Bridge to attach a bone or walnut to a string, and to tie it to a tree observable from the parlour-window; no sooner is the treasure discovered by a tit than he will fly to it and attack it in the most vigorous manner; occasionally he will slide down the string after the fashion of a monkey, and knowingly examine whatever may be attached to it, but more frequently he will hang with his claws to some portion of the bone and swing away, topsy-turvy, as comfortably and unconcernedly as though perched upon a twig. Some years ago a tit built its nest in a hole in the wall close to our house: we discovered its whereabouts by hearing a hissing sound whenever we passed the spot. With some hesitation, we attempted to insert a finger, but it was assailed so lustily that we were compelled to withdraw it. By-and-by we noticed that the bird had left her nest, and we again returned to the

assault; hardly had we attempted to touch the nest, than the little fury actually perched upon our hand, and pecked and hissed desperately. The tits are hard sitters and will sometimes allow themselves to be lifted from off their nests rather than leave them. The long-tailed tits differ considerably from the rest; they generally visit us in flocks during the winter months, but a few remain during a portion of the summer. They are very graceful, and their long black tails with white outer edge add greatly to the grotesque beauty of their movements. The parent birds rarely separate themselves from their broods until the pairing season of the ensuing year, and so strong is the family association that two pairs are said occasionally to occupy the same nest. If this be the case, it will satisfactorily account for the large number of eggs, amounting to sixteen or eighteen, sometimes found in a single nest. Last season a long-tailed tit built in a larch close to our river; we noticed him constantly at work beneath the bridge, and at last we discovered that he was removing all the cobwebs that he could obtain, doubtless to supply the requirements of his nest.

The wagtails and pipits I do not propose to notice, but I cannot omit that bird, which is, of all others, my especial favourite, the skylark. Who amongst us has not listened with wonder and unbounded pleasure to its ecstatic song? Who has not watched it soaring on fluttering wing,

“Higher still and higher,”

in the clear sky,

“Like an unbodied joy, whose race has just begun”?

And when, at last, it has vanished from our sight or remains but a tiny speck in the blue vault of heaven, its musical note has still lingered on our ear, and whispered to us almost as a message from above—

“Hail to thee, blithe spirit!

Bird thou never wert,

That from heaven or near it,

Pourest thy full heart

In profuse strains of unpremeditated art.

We look before and after,

And pine for what is not;

Our sincerest laughter

With some pain is fraught;

Our sweetest songs are those which tell of saddest thought.

Yet, if we could scorn

Hate, and pride, and fear;

If we were things born

Not to shed a tear,

I know not how thy joy we ever should come near.”

We will now take the large family of birds that has been classed under the name of Finches. Of buntings we have three varieties. The common bunting and the black-headed bunting have both been observed, the former not unfrequently, in the low meadows near the canal. The yellow-hammer is one of the most frequent of

our field birds, but I shall only allude to one of its characteristics. Just as so many of us grow greyer as we grow older, so does the yellow-hammer become of a much more brilliant yellow about the head as he advances in age, and this fact will account for the great difference in colour observable in different birds. The sparrow and the chaffinch are probably the most numerous of any among our British birds. Notwithstanding their immense abundance, the sparrow can rarely be found but in close proximity to the haunts of man. He appears to desert the hill-side, the common, or the forest, and to haunt, in flocks almost numberless, the farm home-stead and the country village. But he does not, by any means, confine himself to country life; in every street of every town throughout the land, and in the dirtiest and most wretched of any of the slums of London—there, in profuse abundance, is the sparrow. The nest of the chaffinch is an extremely pretty structure. When built in a tree, it is generally covered with lichens; but it is a little remarkable that whenever a hedge is selected, where lichen would render it conspicuous, it is carefully avoided. The chaffinch has surely attained considerable proficiency in the art of concealment. The brambling occasionally visits our district in small flocks. During last winter a hawfinch remained for several days in our garden at Hunton Bridge. The greenfinch is very abundant, and the beautiful goldfinch, although greatly reduced in numbers, is still tolerably plentiful. I cannot pass by the name of the goldfinch without entering my protest against the systematic manner in which these birds are victimised by the birdcatchers. I am afraid that the “Small Birds Preservation Act” is, for the most part, a dead letter. A gentleman informs me that he met a birdcatcher on Chipperfield Common who had succeeded in capturing six dozen young linnets in one day, and another of the same fraternity was seen to leave Watford station with twenty-seven young nightingales. The siskin and redpole are gregarious, and during the winter they assail our alder trees in large numbers. I have already alluded to the linnet. It is wonderfully abundant in the neighbourhood of Chipperfield. One day last February more than a hundred were observed, singing most vigorously, on a single tree; by and by they took a long flight over the Common, but again returned to the same tree, and again commenced singing. Last among the finches, the gaudy bullfinch must not be forgotten. He is a peculiarly handsome bird, but is frightfully destructive among the early buds of the gooseberry, the currant, and even the plum. His nest is one of the slightest that we have ever seen, being frequently composed of but a few dry twigs laid loosely together. It appears extraordinary that the eggs should be retained by it, and especially that the restless young should allow themselves to be confined within its limits.

The starling, the Royston crow, the jackdaw, the magpie, and the jay will all be found upon my list, but I am afraid I have been already tedious, and passing them without further notice, I will come at once to the kingfisher. I am glad to be able to announce

that we have a goodly number of these beautiful birds at Hunton Bridge, and I can assure you that they are always objects of interest. They are fond of sitting on the wire fence that borders the river, and from this elevation they watch assiduously for their prey. Presently there is a splash; the king-of-fishers has plunged bodily under the water, and up he comes with a small dace or minnow in his beak; he returns at once to his perch, raps the fish against the iron wire until it is dead, and then proceeds to swallow it entire, head foremost. A few weeks since I noticed two kingfishers, one at either end of a river punt that happened to be moored exactly opposite to my office window. Of course I watched them. They appeared to be engaged in earnest conversation, but after a short time, the bird that I assumed to be the cock sidled along the whole length of the punt until he reached his mate, when he immediately proceeded to feed her in the most affectionate manner. The kingfisher, in common with the owl and some other birds, possesses the singular power, after digesting the fleshy portions of its victims, of disgorging the small bones in the form of pellets. We find quantities of these pellets near its favourite resorts, and I have a few of them with me which I shall be pleased to exhibit. The rapid flight of these birds is very noticeable; they flash past you in a moment, their brilliant colour gleaming in the sunshine, and probably affording some slight idea of the gorgeous beauty of tropical birds. Two years ago a pair of kingfishers that frequented the garden were evidently on the look-out for a locality in which to build. For nearly a fortnight they constantly resorted to a hole in an old ash stump, close to the water. We thought that their choice had been made, and carefully avoided disturbing them. Suddenly they altogether deserted the old ash stump, and appeared to look with favour on a certain rat's hole, about fifty yards higher up the stream. This they quickly abandoned, and eventually selected a bank in quite another portion of the garden. At Hitchin, kingfishers regularly build in a secluded dell from which gravel has been taken. The dell is 300 to 400 yards distant from the stream from which they obtain their food, and about 40 or 50 feet above its level. The ground beneath the holes that they frequent is strewn with the spines of sticklebacks, and occasionally the head of a miller's-thumb is to be found. Close to the nests of the kingfishers is a fox's hole, and it is perhaps a little curious that a carnivorous animal and fish-eating bird should dwell in such close proximity.

Swallows, martins, and swifts are next upon my list. The swallow and the sand martin generally arrive about the same time. Last spring I noticed the first swallow on the 7th of April. The house martin and the swift are somewhat later in arriving. The swallow may fairly be taken as the type of migratory birds; and is there anything more wonderful in the whole range of natural history than that extraordinary instinct which teaches the swallow and other birds to wing their way, before the approach of winter, with unerring certainty, over land and trackless sea, to warmer and

sunnier climes, and once again to hasten to their northern homes when the genial breath of spring invites them to return?

“There is a power whose care
Teaches their way along that pathless coast,
The desert and illimitable air,
Lone wandering but not lost.”

It has been well said that “the home of the swallow is the whole habitable earth. It knows nothing of winter’s cold; its whole life is a continued festivity, and its song an eternal hymn in praise of summer and liberty.” It is quite true that “one swallow does not make a summer,” for isolated birds are occasionally seen during every month of the year; but, not the less for this, it is universally regarded as the auspicious harbinger of spring, and is welcomed with delight by all. Every one must have noticed the extremely graceful movements of these birds, but nowhere can they be seen to greater advantage than when lightly skimming the surface of the water, rising and falling in their flight, or wheeling round in graceful curves, as they chase the tiny insects that constitute their food. Much has been written respecting the habits of the swallow during the winter months. It was formerly believed that they all remained with us in a state of hibernation, and Dr. Johnson makes a statement on this subject which is probably about as correct as many other of the Doctor’s famous dicta. “Swallows,” says Dr. Johnson, “certainly do sleep all the winter. A number of them conglobulate together by flying round and round, and then, all in a heap, throw themselves under water and lie in the bed of a river.” The truth appears to be that by far the larger portion of them migrate southwards during the autumn months, but that a few actually remain and hibernate amongst us. I extract the following from a letter by the Rev. F. O. Morris, published in ‘The Times’:—“I was told by a person, who vouches for it as a fact, that not long ago, he, or a friend of his, watched, one autumn, a brood of young swallows too weakly to be able to follow their parents in their migration, and so the old birds left them in their nests and plastered them up with mud. When spring arrived he was anxiously and daily on the look-out for the old birds. At length they came, proceeded at once to the old nest, removed the plaster-work, and aroused the young ones, who were none the worse for their six months’ incarceration.” Then comes an explanatory foot-note—“By swallows, no doubt the person meant martins.” I must now leave the graceful swallow—

“Flying, flying south,”—

and hasten to complete the remainder of my task.

The whirring note of the nightjar is heard not unfrequently at Hunton Bridge, and one was shot recently at Chipperfield. In the same neighbourhood the green woodpecker is tolerably plentiful. A specimen of the lesser spotted woodpecker has been taken at King’s Langley, and one of the great spotted woodpecker at South End, near Redbourn. The wryneck, or cuckoo’s mate as it is

sometimes called, and the tree creeper, are both common. A nest of the former was found in a cherry tree near King's Langley during the past summer, and the latter builds almost invariably in our own alder trees.

Very similar in form and general appearance to the kingfisher, but infinitely inferior in brilliancy of colour, is the nuthatch. The name of this bird affords an appropriate indication of its peculiar tastes. It is a dreadful nuisance among the filbert stems, and if left to itself will soon make havoc with the filberts. Unfortunately it destroys an infinitely greater number than it can possibly consume, and the ground under our stems is frequently almost covered with the results of its depredations. Its method of nidification is peculiar. Instead of selecting, like other birds, a ready-made hole in which to build, it much prefers to become its own engineer, and to hollow out a suitable domicile with its beak. Having made the hole, it proceeds to barricade the entrance with mud and gravel, and in this manner it builds up a complete barrier against all intruders, leaving only a small front door through which to enter. I have received an interesting anecdote respecting the nuthatch from a gentleman at Hitchin, which I shall venture to repeat. "An old apple tree in our garden," says my friend, "having begun to decay, a hole was made in it by a nuthatch and a little chamber hollowed out at the bottom, sufficiently large to admit of the rearing of a family. Through continuous decay, the aperture became too extended; so that it was necessary to reduce it, and this was done by plastering it up with mud. The nuthatch was allowed peaceable possession of its home for some years; it was then vigorously attacked by a house-sparrow, but the assailant was compelled to beat an ignominious retreat. A wryneck next determined to assault the citadel, and he commenced operations by battering down the parapet. No sooner was this effected than the nuthatch courageously attempted the work of restoration; he persevered for some time, but was at last overcome by superior force and compelled to evacuate his fortress. The wryneck, in his turn, was dispossessed by some starlings, and these birds retained possession until the decay of the tree rendered it untenable. It has recently been occupied by some bats."

Respecting the little wren, I will venture to relate a rather curious incident which happens to have come under our personal observation. Whilst its mate is engaged in sitting, the male bird appears to occupy his time in building additional nests, but never attempts to line them, an accomplishment that may probably appertain to the female. We had often noticed these extra nests, and wondered what could be the meaning of them; their utility was exemplified in a somewhat singular manner. Some boys intruded into our garden, one Sunday morning, and robbed it of a wren's nest which we had carefully watched; no sooner was the nest taken away, than a spare nest close by, which had previously remained unlined, was neatly finished and a new edition of eggs quickly deposited.

The habits of the cuckoo were so fully discussed at a recent meeting of the Society, that I shall not again refer to them. The woodpigeon or ringdove visits us by thousands whenever there is a good supply of beech-nuts, and we may confidently anticipate a large influx of these birds during the coming winter. Nests of the stock-dove have been found near Berkhamstead, at Gaddesden Hoo, and at King's Langley. The one at Berkhamstead was built about a yard down in the hollow trunk of a walnut tree. The turtle-dove is pretty abundant in the neighbourhood; we succeeded in capturing a young one in our own garden. Pheasants, as at present reared, may almost be considered as domestic fowls. It is quite different with the partridge, and I should like to relate a short anecdote respecting it. I am informed by a gentleman, on whom I can thoroughly depend, that the partridge will occasionally, on the appearance of danger, remove all her eggs from a threatened locality to a place of safety. He related to me the following interesting incident. When engaged in ploughing a fallow, he observed the nest of a partridge, not far from the course of the plough; as each furrow was completed and as the plough approached nearer and nearer to the nest, it was found that the eggs gradually decreased, and before the plough reached the spot all had disappeared.

Only once have I been fortunate in identifying a quail. We were driving along the turnpike road a little to the north of King's Langley, and noticed a strange bird crouching in the grass by the hedge-side. We stopped and carefully examined it. It proved to be a quail. It did not attempt to move, and my daughter had approached almost within reach of it before it took wing and flew rapidly away. It had probably but just arrived from abroad, and was weary with its long flight. The harsh and monotonous note of the corn-crake is of frequent occurrence during the summer months. The peewit is abundant on every side; the heron has occasionally been seen in the low meadows; and those winter visitors—the woodcock and the snipe—have frequently been shot within our district. Of moorhens and dabchicks we have a plentiful supply. A pair of the former hatched a young brood during the summer, and it was most amusing to watch the little balls of black down paddling about in the stream. The coot is said to frequent the Tring Reservoirs, and one was taken some years ago at King's Langley. Lastly, and I am sure you will be glad to hear that welcome word, flocks of wild ducks may often be seen during the winter, flying with outstretched necks, far, far above us, to a more secluded and sheltered resting-place.

It will be observed that among the birds reported to have been shot at Great Munden are some that are exceedingly rare; several of them being essentially sea-birds. It is probable that they may have been driven inland by stress of weather, and I think that they can hardly be regarded as birds of the district. The kite, the two buzzards, and the raven have but very rarely of late years been taken in the home counties, and in this instance, it must

be remembered that it is now several years since most of them were shot. Since commencing this paper, I have been informed that an African widdah bird has been shot by Mr. Willshin on his farm at South End, near Redbourn. I mentioned the fact to Mr. Harting, and he considers that the non-migratory habits of this bird render it in the highest degree improbable that it could have found its way to this country unaided, but that it was, in fact, an escaped cage-bird. Only by yesterday's post I received from Mr. James H. Tuke, of Hitchin, some interesting notes respecting birds near that town. I shall ask leave to read the paper before we separate, and I shall add the names of any of the birds referred to, which have not been previously recorded, to my classified list.

I have now glanced very rapidly at a few of the leading characteristics of most of the birds that frequent our district. I have done so, I well know, in a very imperfect and superficial manner, but I hope that I may have succeeded in exciting some little interest in the subject that we have under discussion. Had I possessed sufficient anatomical knowledge to enable me to do it, I should have liked to lay before you a few particulars respecting the marvellous adaptability of structure, exhibited by almost all our birds, to the circumstances by which they are surrounded, and to the method of their lives. The strong talon of the hawk, the eye of the owl, the peculiar appliances of the butcher-bird, the clasping claw of the little creepers, the wing of the swallow, the egg of the cuckoo, the webbed foot of the water-fowl, and a host of other not less striking characteristics, would have afforded a wide field for comment. Whether these peculiarities or adaptations are the result of progressive development; whether, in other words, the necessities and exigencies of life have engendered in each bird its peculiar characteristics, or whether these peculiar characteristics have themselves determined the destiny and manner of its life, is a problem that I shall not even attempt to solve.

So far as Creative power is concerned, I confess that it appears to me to be of extremely little import which of these theories is the true one; whether it has pleased the Almighty to place His creatures on the earth He had prepared for them in their present forms, or whether He saw fit to endow them with certain germs of life which should enable them, by slow degrees, to develop new faculties and assume higher functions. This certainly is a most important question for scientific investigation, but it is one that need not, in the smallest degree, interfere with our estimate of the infinite wisdom and almighty power of Creative skill. It is surely pleasant to recognise in everything by which we are surrounded, be it animate or inanimate nature, the direct impress of divine goodness, and to realise as far as possible the truth of Pope's well-known couplet—

“All are but parts of one stupendous whole,
Whose body nature is, and God the soul.”

APPENDIX.*

Birds observed in the neighbourhood of Hunton Bridge and King's Langley.

OSCINES.

Daulias Luscinia—Nightingale.
Ruticilla Phœnicurus—Redstart.
Erithacus Rubicula—Redbreast.
Pratincola rubicola—Stonechat.
P. rubetra—Whinchat.
Saxicola Cœnanthe—Wheatear.
Turdus viscivorus—Missel Thrush.
T. musicus—Song Thrush.
T. iliacus—Redwing.
T. pilaris—Fieldfare.
T. Merula—Blackbird.
T. torquatus—Ring Ousel.
Cinclus aquaticus—Dipper.
Troglodytes parvulus—Wren.
Regulus cristatus—Gold-crest.
Phylloscopus collybita—Chiffchaff.
P. Trochilus—Willow Wren.
Sylvia rufa—Whitethroat.
S. curruca—Lesser Whitethroat.
S. salicaria—Garden Warbler.
S. atricapilla—Blackcap.
Acrocephalus arundinaceus—Great Reed Warbler.
Calamodrus schœnobœnus—Sedge Warbler.
Parus major—Great Titmouse.
P. cœruleus—Blue Titmouse.
P. ater—Coal Titmouse.
P. palustris—Marsh Titmouse.
Acredula caudata—Long-Tailed Titmouse.
Lanius collurio—Red-backed Shrike.
Muscicapa grisola—Spotted Flycatcher.
Motacilla lugubris—Pied Wagtail.
M. sulphurea—Grey Wagtail.
M. Rati—Yellow, or Ray's, Wagtail.
Anthus trivialis—Tree Pipit.
A. pratensis—Meadow Pipit.
Accentor modularis—Hedge Sparrow.
Pyrhula europæa—Bullfinch.
Ligwinus Chloris—Greenfinch.
Carduelis elegans—Goldfinch.
C. spinus—Siskin.
Linota linaria—Mealy Redpole.
L. cannabina—Linnet.
Coccothraustes vulgaris—Hawfinch.
Fringilla cœlebs—Chaffinch.
F. montifringilla—Brambling.
Passer montanus—Tree Sparrow.
P. domesticus—House Sparrow.
Emberiza miliaria—Bunting.
E. citrinella—Yellow Hammer.

Emberiza melanocephala—Black-headed Bunting.

Sturnus vulgaris—Starling.
Pica rustica—Magpie.
Garrulus glandarius—Jay.
Corvus Monedula—Jackdaw.
C. frugilegus—Rook.
C. corone—Carrion Crow.
C. Cornix—Hooded, or Royston, Crow.
Certhia familiaris—Tree Creeper.
Sitta cœsia—Nuthatch.
Hirundo rustica—Swallow.
Chelidon urbica—House Martin.
Cotyle riparia—Sand Martin.
Alanda arvensis—Skylark.

VOLUCRES.

Picus minor—Lesser Spotted Woodpecker.
Geocinus viridis—Green Woodpecker.
Yunx torquilla—Wryneck.
Cuculus canorus—Cuckoo.
Caprimulgus europæus—Nightjar.
Cypselus Apus—Swift.
Alcedo Ispida—Kingfisher.
Columba Palumbus—Ring Dove, or Wood Pigeon.
C. Cœnas—Stock Dove.
Turtur auritus—Turtle Dove.

ACCIPITRES.

Aluco flammeus—Barn Owl.
Strix stridula—Brown, or Tawny, Owl.
Accipiter Nisus—Sparrow Hawk.
Falco Tinnunculus—Kestrel.

GALLINÆ.

Phasianus colchicus—Pheasant.
Caccabis rufa—Red-legged Partridge.
Perdix cinerea—Common Partridge.
Coturnix communis—Quail.

GRALLATORES.

Ardea cinerea—Heron.
Scolopax Rusticola—Woodcock.
Gallinago gallinaria—Common Snipe.
Limnocyptes Gallinula—Jack Snipe.
Vanellus cristatus—Lapwing.
Crex pratensis—Corn Crane.
Gallinula chloropus—Moor-hen.
Fulica atra—Coot.

NATATORES.

Podiceps cornutus—Dusky Grebe.
P. minor—Little Grebe, or Dabchick.
Anas Boschas—Wild Duck.

* The classification and nomenclature in this Appendix are in accordance with Wharton's 'List of British Birds,' 1877.—ED.

Birds reported as having been shot several years ago at Great Munden and still preserved in the vestibule of Munden House.

Corvus Corax—Raven.
Buteo vulgaris—Buzzard.
Pernis apivorus—Honey Buzzard.
Milvus iclinus—Kite.
Machetes pugnax—Ruff.
Edicnemus Scolopax—Stone-curlew.
Larus fuscus—Lesser Black-backed Gull.
Sula bassana—Gannet.

Anser segetum—Bean Goose.
Mareca Penelope—Widgeon.
Nettion Crecca—Teal.
Spatula clypeata—Shoveller.
Fuligula cristata—Tufted Duck.
F. marila—Scaup.
Clangula Glaucion—Golden-eye.
Mergus albellus—Smew.
M. serrator—Red-breasted Merganser.

Birds observed in the neighbourhood of Hitchin and reported by Mr. James H. Tuke.

Turdus torquatus—Ring Ousel.
Locustella naevia—Grasshopper Warbler.
Lanius excubitor—Great Grey Shrike.
Plectrophanes nivalis—Snow Bunting.
Corvus corone—Carrion Crow.

Asio Otus—Long-eared Owl.
Buteo vulgaris—Buzzard.
Falco Esalon—Merlin.
Actitis hypoleucos—Common Sand-piper.
Edicnemus Scolopax—Stone-curlew.

Birds shot at South End, near Redbourn.

Picus major—Great Spotted Woodpecker. *Asio accipitrinus*—Short-eared Owl.

3.—NOTES ON BIRDS OBSERVED NEAR HITCHIN.

By JAMES H. TUKE.

Communicated by J. E. LITTLEBOY.

[Read 8th November, 1877.]

OWING to the unwearied and savage warfare waged against vermin by the gamekeepers, the Raptores are daily becoming scarcer and scarcer, and, with the exception of a few kestrels or sparrow-hawks, they are almost extinct. One merlin and one common buzzard have come to my knowledge during the past ten years. The brown owl, the barn owl, and the long-eared owl, all breed occasionally, but in spite of the services they render, they are shot whenever seen. The short-eared owl is an autumn visitor. In passing, I may notice the very early incubation of the long-eared owl. One egg I possess was taken about the middle of February. The magpie, from the cause mentioned above, is extinct in our neighbourhood, but the bright blue of the jay's wing is happily seen, and its harsh cry still heard in the woods. The carrion crow is also rarely seen. The grey shrike has been obtained at intervals, and I am inclined to think would be found to breed if carefully sought for. The common shrike is very plentiful, and its "larder" may not unfrequently be found. A bird-stuffer in the town informs me that he had ten dozen of their eggs brought to him one season. Usually he has four or five dozen in the season, but whether owing to the "Preservation Act," or the higher wages, which make the boys indifferent about the pence, he has had comparatively few eggs brought him during the three or four past years. Three or four dozen nightingales' eggs were previously brought him each season, but for three years he has had none brought him for sale. The goat-sucker breeds in considerable numbers on Mardley Heath, about eight miles from Hitchin, but is only here occasionally. The ring ousel is a passing visitor, but rare.

This district seems to me marked by the absence of several birds either common or by no means rare in other nearly similar districts. Among these, the pied flycatcher, the woodlark, the tree pipit, the tree sparrow, and the wood-wren are marked examples. The titlark even is rare. On the other hand, the hawfinch breeds here in considerable abundance, and, as noticed above, the common shrike is also plentiful. The reed warbler and the grasshopper warbler are by no means uncommon. The swift is very plentiful here, and not less than ten pairs breed yearly in the roof of my house, much to my pleasure. The green woodpecker yearly becomes scarcer, but the spotted is frequently heard, though difficult to see. The wry-neck is very abundant and the nuthatch is not uncommon. Kingfishers also are numerous.

In a district nearly devoid of streams we can have little opportunity of noticing the Waders, and the only one which has come

under my notice is the common sandpiper, which is sometimes seen on the banks of our little stream—the Hiz. The stone curlew or Norfolk plover is a regular visitor on the Chalk downs to the west of the town, where it breeds, though I have never had their eggs from that neighbourhood. The quail and red-legged partridge are also common, as also is the dabchick.

Before closing these hasty notes on the birds around Hitchin, I should like to call attention to how much may be done, even in a small space, by carefully protecting birds. Immediately adjoining the town of Hitchin, on the road to the station, from which it is not distant more than a quarter of a mile, my partner, Mr. Seeböhm, and myself, have about seven acres of wood, in which, in addition to the commoner birds, the following have bred:—The sparrow-hawk, rook, jackdaw, hawfinch, turtle-dove, stock-dove, cushat, nightingale, bullfinch, redstart, golden-crest, longtailed tit, and kingfisher. The last named took possession, some years ago, of quite a small sand-pit, which was not more than six feet across, and dug a deep hole in the side of the pit (two feet or more in depth); and in each succeeding year, in various parts of the dell, wherever sand has been dug out, these beautiful birds have brought out one or more broods. Is not Tennyson's "Blue bird of March" intended for the kingfisher, as it commences to utter its curious note and to build, or rather bore for, its nest, early in this month? What is curious about the position of these nests is, that the sand-pits are surrounded by trees and quite away from the small stream which runs through the town. The thrush and blackbird build in large numbers in this little wood, and it is an excellent place for listening to their song. "It's quite a *charm* of birds, sir," as a labourer said to me one day, using quite naturally the words which Chaucer uses in his unrivalled descriptions of the song of birds in the early spring morning.

I do not think the fact of the great variety and individuality of the song of birds of the same species has been sufficiently noted. To me it seems that there is as great an individuality in the notes of the thrush or blackbird as there is in the voices of different people, and I notice the same peculiarity of note going on year after year in what I believe to be the same bird. Blackbirds often have a curious little finishing note, and one especially which I noticed, seemed to sing over and over again the name of a gentleman of my acquaintance, in a manner which I have never heard before or since; and what note is there which equals in depth and melody the early morning note of the blackbird—which, quite distinct from that in the after part of the day, seems to come forth as a morning anthem of praise and joy! In addition to the birds, the fox, the rabbit, and the hedgehog all breed in the wood.

4.—FURTHER NOTES ON OUR BIRDS.

By JOHN E. LITTLEBOY.

[Read 13th December, 1877.]

MAY I be allowed a few words in addition to the paper I read last month, and also in reply to the remarks of our ex-President respecting the removal of her eggs by the partridge? I will take the question respecting the partridge first. I have made inquiry in reference to the particular incident I alluded to, from my informant, Mr. Thomas Procter, of Gaddesden Hoo, and he tells me that the partridge nest he noticed was constructed upon the headland of a fallow; that, as every furrow was completed, the horses turned round within a few yards of the nest; and that not only were the eggs gradually removed from it, but that he actually discovered the new nest, not far distant from the old spot, to which the partridge was conveying them. They were all transferred in safety, and in due time most of them were hatched. Mr. Procter was not successful in ascertaining the *modus operandi* by which the transport of the eggs was effected, but I think that the fact of their removal by the parent bird is placed beyond the question of doubt. I am also informed by the same gentleman of an interesting fact respecting the partridge, which is, I think, worthy of record. A few years ago a hay-rick on an adjoining farm was allowed to remain for some time with a few trusses cut out from the top of one of its corners; on the workmen returning to cut the remaining portion, they found the nest and eggs of a partridge on the ledge previously left. The nest was at least ten feet from the ground. I believe this to be a very unusual occurrence; it is, of course, well known that partridges build almost invariably upon the ground, and I have never before heard of an exception to this rule.

In my last paper I mentioned the fact of thirteen brown or tawny owls being driven at one time from a pigeon house at Chipperfield. These birds usually resort to holes or clefts in the trunks of trees, and the fact of their being found in a pigeon house may probably have appeared strange to those who know their habits. I am able, I think, satisfactorily to explain the vagary. These owls had for many years frequented an adjoining wood, but several of the trees which had heretofore supplied them with a home fell before the stroke of the axe. "Necessity knows no law," and in their homeless and destitute condition, they availed themselves, doubtless with a sense of thankful appreciation, of the ready shelter afforded by a neighbouring dovecot.

Respecting kestrels, I am glad to be able to append an additional fact. I am informed by Mr. William Copeland that a brood of six young birds was hatched during last summer in the cleft of an oak at Russell Farm.

I have to report an addition of three birds to the list previously read.* On the 14th of November we had the pleasure of identifying a ring ousel (*Turdus torquatus*) in the most satisfactory manner. We observed it from the turnpike-road between Hunton Bridge and King's Langley, at a distance from us of about 20 or 30 yards. It was seen a second time on the 21st of November, at almost precisely the same place. The ring ousel is abundant during the summer in Scotland, and in some parts of the North of England. I have but little doubt that the bird we were fortunate enough to notice was merely a passing visitor, journeying from its northern abode to winter quarters. It is said to select Corsica and other of the Mediterranean Islands as its winter retreat. My friend Mr. Fletcher Harris, of Leighton Buzzard, informs me, also, that on three different occasions he has observed specimens of a decidedly uncommon grebe upon the Tring Reservoir. At first he believed it to be the red-necked grebe (*Podiceps rubricollis*), but on closer examination he has no hesitation in identifying it as *Podiceps cornutus*, or the "dusky grebe." It is stated by Meyer as a "remarkable fact in the character of this species, that it generally swims about near the shore and scarcely ever dives on the approach of danger till it becomes imminent." This characteristic is strikingly confirmed by Mr. Harris, who writes to me as follows:—"The three birds I saw were much larger and more slim than the dabchick. They were almost close to the side, and although I tried to frighten them, they did not take any notice. Most of the coots, of which I think I saw between thirty and forty, went off into the reeds directly they saw me." The dusky grebe is said to be a permanent resident in many parts of Scotland. It is reported as having been shot at Weston Favell, near Northampton, and also in the neighbourhood of Oxford, in both cases during the winter months, but I cannot discover that it has previously been seen in Hertfordshire. Lastly, I find that the carrion crow (*Corvus corone*) has been observed near Rousebarn-lane, in the lower portion of Cassiobury Park. Perhaps I had better state, before I conclude, that a small Wader has been observed by Mr. Thomas Toovey, in the low meadows near King's Langley. He believes it to be one of the sandpipers, but has not been able definitely to identify it; possibly some of our members may be able to look up the interesting stranger and report its name to a future meeting of the Society.

* See p. 31. The three additional species are incorporated in the list.

5.—REPORT ON PHENOLOGICAL OBSERVATIONS IN HERTFORDSHIRE IN 1876.

By JOHN HOPKINSON, F.L.S., &c., Hon. Sec.

[Read 13th December, 1877.]

At one of the earliest meetings of our Society I drew attention to the steps which have been taken by the Meteorological Society of London to obtain a series of observations of certain periodical natural phenomena, or phenological phenomena as they have been termed; and I requested the assistance of our members in the compilation of a Naturalists' Calendar for the County of Hertford, giving a list of the species to be observed and instructions for their observation.* To this request, I regret to say that only one member has responded by carrying out a systematic series of observations. I allude to Lieut. R. B. Croft, F.L.S., of Great Cozens, Ware, from whom we had a suggestive paper on the subject at the June meeting last year,† and to whom we are also indebted for some notes from a friend at Ware, who is not a member of our Society. A few communications have also been received from other members, but these are almost entirely confined to observations on the nightingale and the cuckoo. The following report gives therefore, with a few exceptions, the results of the observations of Lieut. Croft and his friend, Mr. S. J. Carter, for Ware, and myself only for Watford.

Taking the species in the order given in the table ('Trans.' vol. i. p. 36) we have first to record the dates on which the flowers of certain plants were observed to be open; and here we at once meet with a difficulty, due entirely to the small number of our observers. It is impossible for one person to observe all the species selected, or to say, for instance, that any species observed to be apparently just in flower did actually open its flowers for the first time on a certain day, while, with such a corps of observers as our Society might furnish, few species ought to escape the detection of their flowers when first open. This difficulty may be partially overcome by assigning from the observers' notes, or from the appearance of the specimens when these have been collected and forwarded, a date for the first flowering, not always that on which the flower was first seen, but sometimes a few days before. For instance, if a plant is recorded to have been generally in flower on a certain day, it may be inferred that some days have elapsed since its first flower opened, and if a specimen received has some flower or flowers in seed, or nearly so, the same conclusion will also be drawn. An earlier date than that recorded should in such cases be given as the probable date. In the following table in all instances in which it is certain that a plant opened its flowers before the date observed, two or three days have been subtracted from the

* Transactions, vol. i. p. 33.

† *Ibid*, p. xxxix.

date registered, and these altered dates are indicated by a (?) as in the Rev. T. A. Preston's reports published by the Meteorological Society.

No.	Species.	Watford.	Ware.
1.	<i>Anemone nemorosa</i> (wood anemone)	Mar. 21	Mar. 24
2.	<i>Ranunculus Ficaria</i> (pilewort)	Mar. 23	Mar. 25
3.	<i>R. acris</i> (upright crowfoot)		Apl. 28
4.	<i>Caltha palustris</i> (marsh marigold)		Mar. 15
5.	<i>Papaver Rhæas</i> (red poppy)	June 2	June 8
7.	<i>Cardamine pratensis</i> (cuckoo flower)	Apl. 20 (?)	Apl. 15
9.	<i>Viola odorata</i> (sweet violet)	Mar. 11	
10.	<i>Polygala vulgaris</i> (milkwort)		June 14
11.	<i>Lychnis Flos-cuculi</i> (ragged Robin)	June 2	June 8
12.	<i>Stellaria Holostea</i> (greater stitchwort)	Apl. 20 (?)	Apl. 4
13.	<i>Malva sylvestris</i> (common mallow)	June 10 (?)	June 9
16.	<i>Geranium Robertianum</i> (herb Robert)	Apl. 30	May 7
17.	<i>Trifolium repens</i> (Dutch clover)	May 28	May 29
18.	<i>Lotus corniculatus</i> (birdsfoot trefoil)	May 27 (?)	May 25
19.	<i>Vicia Cracca</i> (tufted vetch)	June 30	June 30
20.	<i>V. sepium</i> (bush vetch)	Apl. 23	Apl. 27
21.	<i>Lathyrus pratensis</i> (meadow vetchling)		June 12
22.	<i>Prunus spinosa</i> (blackthorn)	Apl. 6 (?)	Apl. 6
23.	<i>Spiræa Ulnaria</i> (meadow-sweet)	June 30	June 23
24.	<i>Potentilla anserina</i> (silver-weed)		May 22
25.	<i>P. Fragariastrum</i> (barren strawberry)	Mar. 22 (?)	Mar. 23 (?)
26.	<i>Rosa canina</i> (dog rose)	June 11	June 12
30.	<i>Anthriscus sylvestris</i> (wild chervil)	Apl. 26	Apl. 20
32.	<i>Galium Aparine</i> (cleavers)	May 25 (?)	May 31
33.	<i>G. verum</i> (yellow bedstraw)		June 30
37.	<i>Tussilago Farfara</i> (coltsfoot)	Mar. 23	
38.	<i>Achillea Millefolium</i> (milfoil)		June 24
39.	<i>Chrysanthemum Leucanthemum</i> (ox-eye)	May 28 (?)	May 31
41.	<i>Senecio Jacobæa</i> (ragwort)	June 24	
42.	<i>Centaurea nigra</i> (black knapweed)		June 26
44.	<i>Carduus arvensis</i> (field thistle)	July 1 (?)	July 1 (?)
46.	<i>Hieracium pilosella</i> (mouse-ear)		May 21
47.	<i>Campanula rotundifolia</i> (hairbell)	July 9	
50.	<i>Symphytum officinale</i> (comfrey)		May 23
52.	<i>Veronica Chamædrys</i> (germander speedwell)	May 4	May 2
55.	<i>Thymus Serpyllum</i> (wild thyme)		June 26
57.	<i>Nepeta Glechoma</i> (ground ivy)	Apl. 6	Mar. 30
59.	<i>Stachys sylvatica</i> (hedge woundwort)	June 18	June 9
60.	<i>Ajuga reptans</i> (creeping bugle)	May 12 (?)	May 7
61.	<i>Primula veris</i> (cowslip)	Mar. 18	Mar. 29
62.	<i>Plantago lanceolata</i> (ribwort)	Apl. 17 (?)	Apl. 14
63.	<i>Mercurialis perennis</i> (dog's mercury)	Mar. 25	
67.	<i>Orchis maculata</i> (spotted orchis)	June 3	June 14
68.	<i>Iris Pseudacorus</i> (yellow iris)	June 10	June 12
71.	<i>Endymion natus</i> (blue-bell)	Apl. 23	

Of the 45 plants enumerated in this table, it will be seen that 34 were observed by myself in the neighbourhood of Watford, and 39 by Lieut. Croft and Mr. Carter near Ware. When the same species was seen first in flower on different days by the two observers for Ware, the earliest date is entered. The dates appear on the whole to be slightly earlier at Watford than at Ware, a result we might have anticipated from the position of the two places; and it is more than probable that had there been two

observers at Watford as well as at Ware, still earlier dates would have been recorded for the former place, making the difference more apparent. Of the 28 species observed in both localities, 14 appear to have been out earliest at Watford and 11 at Ware, while 3 are entered to the same day. Taking, however, three days as a sufficiently near interval to be considered synchronous, we have 12 species which may be said to have come into flower at the same time in both localities, while the greatest observed amplitude (in *Stellaria Holostea*) is only sixteen days.

We have next to consider the reports which have been received concerning the insects and birds, etc., in the Meteorological Society's list. These cannot so well be entered in a tabular form as in the case of the plants, but the results may be almost as briefly expressed. The initials used refer to the observers already mentioned.

75. *Pieris Brassicæ* (large white cabbage-butterfly). Seen at Watford, April 30—J. H.

76. *Pieris Rapæ* (small white cabbage-butterfly). Seen at Ware, April 4—R. B. C.; Watford, April 9—J. H.

79. *Trichocera hiemalis* (winter gnat). Seen at Watford, December 25, 1875, to March 1—J. H.

81. *Muscicapa grisola* (flycatcher). Seen at Ware, May 22—S. J. C.

82. *Turdus musicus* (song thrush). Heard at Watford, December 25, 1875—J. H.

84. *Daulias Luscinia* (nightingale). Heard at Watford, April 20—J. H.; Cassiobury, April 22—Lord Essex; Ware, April 21—S. J. C.; April 22—R. B. C.; Odsey, April 22—H. G. Fordham. One caught in Mr. Harford's conservatory, Watford, April 19.

88. *Alauda arvensis* (skylark). Heard at Watford, December 25, 1875—J. H.

90. *Corvus frugilegus* (rook). Began to build at Russell Farm, Watford, February 8—W. Copeland.

91. *Cuculus canorus* (cuckoo). Heard at Pinner, Middlesex, April 21—Dr. Brett; Ware, April 21—R. B. C.; April 23—S. J. C.; Cassiobury, Watford, April 22—Lord Essex; Munden Park, Watford, April 22—J. H.

92. *Hirundo rustica* (swallow). Seen at St. Albans, April 22—Rev. C. M. Perkins; Ware, April 23—R. B. C. and S. J. C.; Watford, April 25—J. H.

93. *Cypselus Apus* (swift). Seen at Watford, May 16—R. B. C.; Ware, May 19—S. J. C.

97. *Rana temporaria* (common frog). Spawn seen at Ware, April 4—R. B. C.

Amongst the above there are a few species, usually first appearing about the beginning of the year, which date back to the end of the preceding year. These are rightly included in the report for 1876. For the year 1875 we have also, however, a few other records which I will here give.

5. *Papaver Rhæas* (red poppy). Watford, May 27—J. H.

11. *Lychnis Flos-cuculi* (ragged Robin). Watford Heath, May 29—J. H.

39. *Chrysanthemum Leucanthemum* (ox-eye). Watford, May 23—J. H.

49. *Convolvulus sepium* (greater bindweed). Watford, July 5—J. H.

50. *Symphytum officinale* (comfrey). River Colne, Watford, by May 19—J. H.

84. *Daulias Luscinia* (nightingale). Heard at Odsey, April 19—H. G. Fordham.

91. *Cuculus canorus* (cuckoo). Heard at Watford, April 17—A. Cottam; Russell Farm, Watford, April 19—W. Copeland.

92. *Hirundo rustica* (swallow). First seen at Watford, April 18, last seen November 20—J. King. First seen at Odsey, April 27—H. G. Fordham.

Comparing these few records with those for 1876, it is at once seen that in 1875 plants were considerably earlier in flower than in 1876, and that birds appeared also a few days earlier. A further comparison of one year with another may be made in future reports, but we can now only draw attention to the fact that 1876 was "a late year," this being due, as reference to any meteorological register would show, to the coldness of the spring and early summer—the temperature of the months of March to June inclusive being considerably below the average.

It only remains for me to ask for more assistance than I have hitherto received, so that future reports may be more worthy of our Society. Any notes that may have been made during the year now drawing to a close will be gladly received; and I would especially urge upon those of our members who have frequent opportunities of taking walks in the country—and there must be many who have, and who would perhaps more often take a country walk if they had an object in view—to note down next year the time of flowering of as many of the plants in our list as they possibly can, and to forward their notes monthly to me, together with specimens of the flowers, when these can be procured. The entire plants are not required, and the flowers need only be roughly pressed, by placing them within the leaves of a book for instance. Observations of as many as possible of the insects and birds also should be made; but it is not necessary that any one member should take the entire list of species—some may observe the plants, others the insects, others the birds. There are few among us who do not notice some of these. "In fact," as Lieut. Croft said in his paper before referred to, "we all do notice these occurrences, though we may not record them." This is what is required—not merely to look out at the commencement of the new year for the first snow-drop, and to listen daily from about the middle of April for the first note of the cuckoo and nightingale, but also to record what is observed.

6.—THE PRODUCTS OF HERTFORDSHIRE.

By the Rev. JAMES C. CLUTTERBUCK, M.A.

Communicated by A. T. BRETT, M.D., President.

[Read 10th January, 1878.]

WHEN it was suggested that I should read a second paper before this Society, the Products of Hertfordshire seemed to be a subject on which I might have something to say. As in the case of the neighbourhood of Watford, the county may be divided into two parts—that to the south being covered by the Tertiary beds, that to the north being Chalk, for the most part covered with loam, gravel, and some outlying patches of the Tertiary beds *in situ*, its northern limit verging on the Upper Greensand and Gault clay.

This geological condition will rule most of the natural and artificial products of the county. Of the natural products the forestry claims the first place. Here I am met with the difficulty that this ground has already, happily for this Society, been occupied in a great measure by Canon Gee. Nevertheless, without treading too closely on his steps, something still remains to be said on the conditions, geological and physical, under which some of the forestry of Hertfordshire has been produced.

The chief natural product of all countries is their forestry. It would be difficult to separate the strictly indigenous trees from those introduced from foreign countries. The oak, elm, and ash may at least be classed with the former. As a boy, more than sixty years ago, I often saw the Panshanger Oak, then without a trace of decay upon it. The Burnt Oak in Oxhey-lane, though a wreck, was still alive at that same period. A younger tree, I believe, now marks the division of the two counties. If I remember rightly, the old tree was spoken of as such in the reign of Charles the Second. The oaks growing, as this, on the Tertiary beds, for the most part thrive better than those in the Chalk district, which, as woodland or hedgerow timber, with some exceptions, are of a stunted and unthrifty growth. Some of the finest oaks I remember to have seen in Hertfordshire were growing on the outcropping Gault, or, as sometimes called, oak-tree clay, at Hinksworth, at the extreme north of the county. The elm known as the Hertfordshire Elm has been called the weed of the county. With a greater development on deeper soils, it seeks its nourishment by spreading its roots nearer the surface than the oak. The Hertfordshire Ash bears a good name, and fetches a high price as wheelwrights' timber, though it is no favourite with cultivators of the soil. We know that it formed the shafts of the spears of our Saxon forefathers, proving at least its antiquity as a product of this county. The beech, we are told, on the authority of Cæsar (as stated by Canon Gee), is not indigenous, yet no tree covers a larger extent of ground, even to the exclusion of the undergrowth

of coppice permitted by other forest trees. I am not sure that we are told by Cæsar of what trees the forestry consisted in this part of the county, of which he says of the Cassii and others: "*Ab iis cognoscit, non longe ex eo loco oppidum Cassivellauni abesse, silvis paludibusque munitum, quo satis magnus hominum pecorisque numerus convenit. Oppidum autem Britanni vocant, quum silvas impeditas vallo atque fossâ munierunt, quo incursionis hostium vitandæ causa convenire consueverunt.*" The beech on the Chalk, especially on the escarpment overhanging the Vale of Aylesbury, furnishes material, which it shares with the elm, oak, ask, and, I believe, cherry, for the manufacture of chairs, of which Wycombe is the well-known centre. In vindication of this distinction, we lately learned that the Queen, when on her progress to visit the Prime Minister, stayed on the way to look at and admire, before she passed under, a triumphal arch composed of chairs. Whether any portion of these chairs was of Hertfordshire growth we must be content to be ignorant. The chestnut—the Spanish chestnut as it is called—whether indigenous or imported, as you have been told by Canon Gee, attains very large dimensions and great age. It enters into the construction of many of our oldest buildings, and is often from its similarity to oak mistaken for it. According to Clutterbuck, the Wymondley Chestnut is described in Gilpin's 'Forest Scenery,' and it is said that in 1789 it measured fourteen yards in circumference at five feet from the ground. I have a drawing of the Wymondley Chestnut by Thomas Hearne, a well-known artist of the last and present century, who lies buried with his brother-artists, Edridge and Henry Monro, in Bushey churchyard. The drawing is dated 1795. The tree is spoken of by Canon Gee as a wreck. A comparison of this very elaborate drawing with the present tree would show the effect of more than 80 years on that venerable production of Hertfordshire soil.*

Of trees of foreign rather than English origin, the fir grove at Cassiobury shows the size to which this tree may attain in a soil suited to its growth—probably a deep loam on gravel resting on chalk. There is an old and interesting book, written by Moses Cook, gardener to the Earl of Essex, bearing date 1724, on the manner of raising, and ordering, and improving forest trees. He speaks of planting the lime trees, in and about that seat of the Earl of Essex, whom he alludes to as a great planter; thus we have a clue to the age of the lime trees at Cassiobury,† most of these trees having been raised by him at Hadham Hall. The cedar attains gigantic growth at Chorleywood. It has been observed by a person well skilled in forestry that some of the largest trees are found where there is subsoil water, as in this case, and that its removal endangers the life of the tree. I know some cases in which this has been the effect on elm trees. When it was proposed by the Thames Conservancy to lower the level of the Thames where that

* A very clever copy of this drawing has been presented to the Society by Mr. Clutterbuck.—ED.

† Many other trees were most probably planted here at this time.

river bounds the Home Park at Windsor, with a view of relieving the Queen's drive of floods, by the advice of Mr. Menzies, the surveyor of the park, this was not carried out, lest the noble elms in that part of the park should suffer from the level of the subsoil water being thus lowered.

Not to trench on ground already occupied, the coppice underwood is for the most part hazel. This is used for the ordinary purposes of underwood; but, as I remember well, having often as a boy watched the doings of a wood-turner, the hazel rods are sometimes cut into short lengths and turned into various forms used in the manufacture of tassels and the like in furniture. The produce of these trees being deemed of wild growth, and therefore common property, is often sought by strangers to the detriment of the underwood. The soil suited to the hazel is also fitted for the cultivation of the filbert as a marketable article.

The cherry is the principal fruit-bearing tree of the county; its wood is not without its proper use. I do not know if its growth is continued as extensively as of old. It is mostly found on the higher levels of the chalk district, where the chalk is covered by thick beds of loam resting on gravel. When viewed from the higher ground when the cherry-trees are in blossom, the orchards have the appearance of patches of snow. Though the season of the year dissipates this illusion, it gives no security against the late and untimely frosts by which the promise of the future crop is so often destroyed in a single night. The age of many of the trees shows that the culture of the cherry is of ancient date. The commercial value of the fruit is considerable. Often bought on the trees by dealers, much of the fruit finds its way into the manufacturing districts, where it is used in dyeing; it is used also in making cherry brandy, and, if report be true, enters largely into the composition of liquors to which it does not give its name. The chief sorts are the small Hertfordshire black and caroon (spelt *corowne* in the book already spoken of). The wild uncultivated tree grows freely in the woodlands, and affords stocks on which the fruit-bearing trees are engrafted. The north-western limits of the county either in part comprehend or verge upon a district in which the plum is extensively and successfully cultivated, subject to the drawbacks it has in common with the cherry orchards in the central parts of the county.

The greater part of the soil of Hertfordshire is under arable cultivation; the portion occupied by meadow or grass land is almost confined to that bounded by the county of Middlesex, of which the produce is chiefly made into hay, for which a ready sale is found in London. The process of haymaking, from the critical requirements of the London market, is carried out with much care, not freed from anxiety lest the colour and bouquet should suffer either from the weather or the want of care and judgment in making or stacking. The feeding properties of the grass are not of a high order. The arable land, mostly gravel on chalk, is rather healthy than fertile, and for this reason an old writer has said of

Hertfordshire, "It is the Garden of England for delight, men commonly say that 'such as buy a house in Hertfordshire pay two years purchase for the aire thereof.'" The most fertile district is that of which Hitchin may be deemed the centre. It was from this neighbourhood, known of old as the Vale of Ringdale, that the wheat yielding the flour known as the Hertfordshire White was grown; indeed, it will be found that the district of land under the undulating escarpment of the chalk hills, extending along the southern part of the Vales of Aylesbury and White Horse, produces in quantity and quality some of the best English-grown wheats. The late Mr. Hainworth, of Hitchin, carried out with great success the cultivation of varieties of wheat, some of which at least bear his name. This is a branch of agriculture requiring great care and attention, and is of acknowledged value. There is a wheat extensively grown in Berkshire, known as the Hertfordshire White, which I have reason to believe may be traced to the labours of the late Mr. Hainworth, as first produced by his care in selection, and raised by his intelligence and persevering skill.

Not only is the Vale of Ringdale famed for its wheat-producing quality, but the straw grown in the district is specially adapted for the manufacture of straw-plait, and was probably the primary and chief cause of the establishment of that industry of which Luton, in Bedfordshire, is the acknowledged centre, that place, as shown on the map of either county, being on a tongue of land in the south of Bedfordshire, surrounded on three sides by the county of Hertford. Those who grow the wheat straw to be used for plaiting take great pains to harvest it in such a manner as will insure its coming straight and uninjured from the barn or stack. Straw drawing is a neat and skilful operation, requiring care and practice. Though the chalk district of Bedfordshire, Buckinghamshire, and Hertfordshire furnish considerable quantities of the raw material, it is sought in the Vale of the White Horse, in Berkshire, and Oxfordshire, where the finer sorts of wheat, especially the Chiddam and kindred qualities, are grown. Sometimes, when the plaiting trade and the quality and harvesting is good, the value of the straw will be equal to that of the corn; as the ears are cut off, and the chaff, caving, and flag left behind, there is little waste. The moral effect of this manufacture has often been called in question, and the adjustment of educational requirements with the early age at which children are taught and employed in straw plaiting seems not without its difficulties. Be that as it may, it is clear that straw plait is one of the productions of the county of Hertford, as well as the straw from which it is manufactured.

The neighbourhood of Hitchin is not less remarkable for its wheat than its barley. Of Queen Elizabeth it is said that she gave to the barley the name of "her Hitchin grape." It is said that the wheat she consumed was not the Hertfordshire White, but that grown on the deep loam of Heston, in Middlesex, a soil now well nigh exhausted, having furnished brick earth for the buildings in London—a fate which the soil of Hitchin has escaped. This

still no doubt furnishes the raw material for the manufacture of malt, the extensive trade in which is witnessed by the malt-houses of Ware, Bishop's Stortford, and other places.

The building materials of Hertfordshire are furnished by the Chalk as lime; and the clays of the Tertiary formation, as at Bushey, for the manufacture of bricks; but we must not forget that the clunch, or lower bed of the Chalk, of which the Abbey, now Cathedral, of St. Alban's, and well-nigh all the churches in the county, are more or less built, is found on the northern limits of the county.

It should be remembered that it is to the geological condition of the county that its beautiful streams are due. These drove the mills of our forefathers, as they drive ours, and they find motive power for commercial enterprise unknown to those of old; and looking rather to the days of Isaac Walton than the present, as abounding with trout of exceptionably fine quality, they furnished recreation for some of the best of men, and England's most scientific sons; to old Isaac, or—as he wrote it—Izaak, who begins his well-known and charming book, 'The Complete Angler, or Contemplative Man's Recreation,' with a description of his journey to Ware, as Piscator, in company with Venator and Anceps, to fish in the River Lea, one of his favourite resorts. The value of the rights of fishing at that time, in the Manor of Hertford, may be estimated by having been granted, by King Charles the First, to William, Earl of Salisbury. It was here that Sir Humphry Davy exercised the gentle craft. It was on the banks of the Colne that he found the materials for the opening pages of his 'Salmonia,' and it was by the aid of these waters that the predecessors of your late President gained a triumph of mechanical skill.

In the production of root crops Hertfordshire seems often to have led the way. This produce of the soil, with the diminished value of the chief cereal crops, bids fair to be the staple of the future of English agriculture. The samples of these productions more than ever form interesting features of agricultural shows, and by good and liberal cultivation overcome the difficulties presented by a naturally unproductive soil. The Swedish turnip, of the introduction of which I do not know the exact date, trusting to the accounts of agriculture in the first years of this century, was little, if at all, cultivated in many counties at that time, whereas here its cultivation had extended from the amateur to the practical farmer. I well remember, when travelling in Suffolk in the autumn of 1812, my father, who held a small farm, and always took an interest in practical farming, noticed the fields of Swedish turnips as of unusual occurrence, and though at that time in Hertfordshire the quality of the soil was considered by some unfitted for its growth, for many years past it has formed throughout the county a part of the usual rotation of crops.

Hertfordshire seems, especially at the beginning of the century, to have been a county of experiments by the introduction of machinery

and newly cultivated plants. Mr. Greg, Sir John Sebright, Mr. Rogers Parker, of Munden, Lady Salisbury, and, I may add, my own father, were ready at all times to test the value of new productions. There is a very remarkable record of the cultivation of 17 acres of land under Lady Salisbury's direction, in which we meet with a root not otherwise mentioned, namely mangel wurzel, then, I believe, called the "root of scarcity," as distinguished from ordinary beetroot. I first saw it cultivated by the late Mr. Nicholson Calvert, who at one time represented the county; he showed it and spoke of it as a new introduction in the summer of 1817. We find it before that date, in 1795, cultivated by Lady Salisbury, forming one of the 17 acres from which it is stated that a profit of £462 10s. was realised, chiefly from the sale of 41,000 cabbages at $1\frac{1}{2}d.$ each, grown on 7 acres. The gross produce was £598.

Here the experiments carried on by Mr. Lawes, of Rothamstead, assisted by Dr. Gilbert, deserve especial notice. The details are regularly given to, and are, therefore, before the public. As these experiments are carried on upon that which may be deemed an average soil of a great part of the arable land of Hertfordshire, over and above their great value to agriculture in general, they show how and in what proportion the natural quality and condition of the soil, and the application of various manures, or the absence of all manure, stimulate the production or exhaust its fertility. These experiments show in the plainest and most convincing manner, which of the constituents of the cereals, roots, and other products of the soil, especially of Hertfordshire, are supplied by the atmosphere or are taken up from the soil; and as connected with these experiments, it may be mentioned that one of the manures generally known as artificial is found at the northern extremity of the county. It bears the name of coprolites, which does not truly describe the substances or nodules, more or less consisting of fossils charged with a considerable amount of phosphate of lime, probably due to the breaking up of the beds of the Upper Greensand above the Gault, on the surface of which they are usually found in large quantities. They are ground and chemically treated, and returned to the soil as a valuable mineral manure, a product of the county.

There is a natural production of Hertfordshire, which, within the present century, has been turned to considerable commercial account as a cultivated plant. In times gone by, those who sold watercresses were content, like Goldsmith's

" . . . Wretched matron, forced in age, for bread,
To strip the brook with mantling cresses spread."

Those who cultivate the watercresses now are very different from the "widowed solitary thing" of the poet, now that this trade has assumed such extensive proportions. One word as to the "wretched matron." The deserted village was no doubt suggested to Goldsmith by a village in Ireland, his native land, but, from the village of

Nuneham in Oxfordshire being removed to another site, and one old woman having refused to quit her hovel, which she was permitted to retain till her death, a "widowed solitary thing," the spot where she lived is to this day marked by a tree, named "Bab's Tree." Some have identified the wretched matron of Goldsmith with Widow Bab of Nuneham. More than doubtful as this story is, there is no doubt that the systematic cultivation of the mantling cress was begun in Hertfordshire by Mr. Bradbury, at West Hyde, in the parish of Rickmansworth. He began by renting the ditches of the occupier of a farm in the valley of the Colne. From a small beginning, by cleansing and widening, he increased the area of the beds, regulating the height of the water by artificial dams, and selecting the best sort of watercress, of which that known as the Dutch brown is preferred. Thus Bradbury's cultivated watercress became a regular article of traffic in the London market, and claimed for Hertfordshire and Mr. Bradbury the credit of converting a wild plant into a systematically cultivated product, the present commercial value of which it would be difficult to calculate, or to estimate the area now occupied by its cultivation. I am told that Mr. Bradbury was first encouraged in his expensive experiments by the assistance of the late Mr. Simeon Howard, of Troy, whose ditches he first rented;—not the Troy of Homer; yet, by a somewhat curious coincidence, my son tells me that when serving on board H.M.S. "Triumph," in Besika Bay, he found luxuriously growing watercresses, at the Seven Springs, one of the sources feeding the classical Scamander,—a place often fixed on for refreshment, as furnishing the wild watercress, a welcome addition to the mid-day meal. Few persons are probably aware of the amount of labour and skill required in the cultivation of this simple but highly valued plant. The water must be pure, and flow from the gravel, or immediately from the chalk, and must be constant and well regulated. It must be protected from the ravages of birds, especially the blackbird at certain seasons, and be the object of unremitting care and supervision during the greater portion of the year.

Among the other experiments to extend the produce of the county may be included the growth of hops; this has been done, in one case at least, with some qualified success. There seems at first sight to be no reason why, on the deep loams found in certain spots, the hop should not flourish as well as in parts of Surrey, Sussex, and Kent. The introduction of a new industry, and especially one which requires peculiar knowledge and skill, such as the growth and cultivation of a plant in all its stages, as the hop plant presents in *limine*, is not easily surmounted. As the management of the hop garden is not understood either by the farmer or labourer of Hertfordshire, and as the sites fitted for the purpose are few and far between, and as the soil to the north, which by its quality is most fitted for its production, lacks that natural and artificial shelter which the hop requires, there seems to be abundant reason why the experiment of its growth has been so little ventured upon.

There is another product in which Hertfordshire seems to excel, if we may judge by the reputation of the cultivators of roses at Berkhamstead, Cheshunt, and Waltham Cross. We find that these places are either on the banks or in the valleys of the Lea and Gade; whether these situations are specially favourable to the cultivation and perfect development of this justly popular and fragrant flower, or whether mere accident or peculiar convenience has fixed on these sites, I do not know. Every year makes us acquainted with fresh varieties, and has the happy feature of prolonging the season of the presence of the flowers. The commercial value of the rose is far different from what it was of old, though as to varieties, I remember seeing a rosery of, I think, 400 sorts in the gardens of Cassiobury, more than sixty years ago. The successful cultivation of the rose on either side of the county, and under corresponding conditions, is not without interest, and could scarcely be passed over without notice.

There are doubtless other products which have not suggested themselves to me, and some to which I have done scant justice. For these and other shortcomings I must plead a long absence from residence in my native county, though the same excuse cannot be pleaded for the imperfect account of those I have ventured to bring before you. The chief characteristic of the county is that it has attractions which make it especially residential; it has no grand geological or physical features, no mountains or lakes, no mines, few lofty chimneys. It has its palatial seats, surrounded with beautiful and extensive parks, and its villas and humbler cottages daily springing up, as at Watford; it is gifted, nay blessed, with a soil and atmosphere proverbially healthy, refreshing and invigorating many a hard-worked citizen of London; a naturally pure source of water underlies a great portion of its surface, a large volume of which it parts with by copious springs of unchallenged purity, to supply a large portion of the ever-increasing population of the metropolis, which it rivals, and in some sort excels, in that it now is dignified by a city of its own, bearing a name linked with the undying memory of the past, and sanctified by the sufferings and blood of the proto-martyr of Britain.

7.—ANNIVERSARY ADDRESS.

By the PRESIDENT, ALFRED T. BRETT, M.D.

[Delivered at the Annual Meeting, 14th February, 1878.]

LADIES AND GENTLEMEN,—

When you did me the honour to elect me President of this Society, it gave me great pleasure to find such an expression of your confidence and of your goodwill. But these feelings of gratification were mingled with other feelings of a different nature. I was diffident of my abilities to do justice to the office, both from want of time and because I had not hitherto given special attention to those studies which are usually included under Natural History, my life being chiefly devoted to the study of what may be called abnormal or diseased nature. Besides, I thought that my deficiencies would be more marked, coming after a President such as my predecessor, a man so well and universally known in the scientific world, who has presided over many of the learned and scientific societies in London, and who has lately most deservedly received the highest honour that Oxford could bestow. And, moreover, the knowledge of the fact that it would be expected of me to give an address this evening did not add to my feeling of joy. Not that I wanted a subject on which to address you, for if I consulted the Book of Nature, and selected that volume devoted to the Natural History of Hertfordshire, I should find many parts unread and some of the pages uncut. How little do we know of our fresh-water Algæ, our fresh-water shells, our mosses, our lichens, not to mention the worlds revealed by the microscope. Any of these, or the climate of Watford even, might have afforded me a topic of investigation.

I shall prefer to occupy the short time allowed me this evening in making some remarks on Nature generally. I fear you will think that I take you too much into the regions of speculation and of theory, and that instead of directing your attention to the marvels of Astronomy and Physics, I should have taken a humbler flight and have confined my remarks more to our own county.

In order to facilitate study we adopt what is called the division of labour, and we have each of us our own pet "ology." But we must recollect that Nature is one and indivisible—she does not divide herself thus—she forms one unbroken chain.

“When, one step broken, the whole scale’s destroyed;
From Nature’s chain, whatever link you strike,
Tenth, or ten thousandth, breaks the chain alike:”

It may be useful sometimes to take a general view of the universe, and to endeavour to trace where the different natural sciences interlace with each other, and to find out what general laws animate and govern the whole. A student of medicine is more fitted to take this general view of nature than many people, because he must know a little of so many sciences. His motto should be, “*Homo sum; humani nihil a me alienum puto*,”—“I am a man; I sympathise with everything human,” for all the sciences have their focus in man.

The thoughts that I wish to bring before your notice this evening may be classed under the title of “A Sketch of the Plan of Nature.” Theories of the plan of Nature have always been numerous. Groundless hypotheses regarding the origin of living beings existed in profusion some two centuries ago. Drélinecourt took the trouble to enumerate no less than 262; and Blumenbach quaintly remarks that doubtless his theory formed the 263rd.

During the last few years discoveries have been made and theories have been advanced, which, if followed to their legitimate conclusions, must greatly modify our views regarding the plan and the laws of nature. I allude to the theories which are included under the term Darwinism, the laws of the correlation of forces, the conservation of energy, etc., and to the discovery of that wonderful and suggestive little instrument, the radiometer.

The Nebular Theory of Laplace is the one which is most generally accepted as accounting for the present state of the universe. It supposes that the solar system, and others, once existed in a state of intense heat, in a nebulous condition or as matter finely divided, and that this diffuse mass of matter, gradually cooling, condensed towards its centre and thus formed the sun, while the planets were formed by the condensation of external rings. There are several objections to this theory. If the planets were formed from the same nebulous matter as the sun, they should resemble him in chemical constitution. Now the sun has elements in him, as revealed by spectrum analysis, which are not known to exist in the earth, and some elements exist in the earth which have not been found in the sun. And again we have no historical proof that the sun is gradually cooling, and the evidence of Geology is against the supposition; for we do not find that the climate of the earth has gradually got colder, but we have distinct proof of an alternate hot and cold climate. If the sun is

gradually cooling he could never get hot again. One fact seems to favour the Nebular Theory, which the Germans call the Kosmic-gas Theory, which is, that the earth seems to get hotter the further we descend into the interior; and it is calculated that if the heat increases in the same proportion, the interior of the earth must be molten from heat. I do not think that the interior of the earth is in a state of fusion from heat, and if it is so, a different explanation may be given. But supposing that future investigation should favour the truth of the Kosmic-gas Theory, it would only be one link in the chain of creation. If the solar system arose from a state of nebula, it will, according to the theory I am about to bring forward, again return to that state.

As I shall have to use the words *matter* and *force*, it will be well to explain what I mean by these terms. By matter I mean whatever I can become acquainted with by means of my five senses. I can feel this table, I can hear, smell, see, and taste. If this definition is accepted, it will be seen that matter is divided into two very distinct classes—firstly, things that can be weighed; secondly, things that cannot be weighed. I can weigh the table, but I cannot weigh sound, or light, or thought, or magnetism, or chemical force, or vital force. Although I believe that the imponderable forces are really material, yet for convenience of language we will still call them force or energy, and ponderable matter simply matter. Only it is well to bear in mind that the force of light, or heat, or electricity, is, in fact, as real a thing as a ton of Hertfordshire conglomerate. Matter and force are indispensable to each other; it is impossible to imagine matter without force, and it is difficult to imagine force without matter. Force is the active part of nature, matter is the passive. Force is by far the most important of the two, besides, it is much greater in extent. Matter occupies mere specks in space; force fills the immense intervals, and besides this, it penetrates, saturates, and animates all matter. In order to understand the theory which I wish to bring before you, it is desirable to bear in mind some of the laws of matter and force. They both agree in this property—they are indestructible. But they differ in this, that whereas force is correlative, or one form of force may pass into another form, yet with ponderable matter it is not so. We cannot change one element of matter into another. Matter and force, if once set in motion, must continue in motion for ever. The most important property of matter and force is that they are always in motion. Rest does not exist in nature. “Motion is the law of nature; it is only rest that is abnormal.” Now if matter is endued with

perpetual motion, it probably moves in a circle. I cannot imagine matter and force moving in straight lines, from the eternity past to the eternity to come, through infinite space. The plan of nature probably is perpetual circular motion. Of course it is impossible for man to construct any machine that can have perpetual motion, for this reason—part of the force with which the machine is endowed must escape and be absorbed and used by surrounding bodies. But taking the universe, where no part of matter or force can really be lost, perpetual circular motion is not only possible, but it is the only theory which will account for nature always continuing the same.

The prevalence of this law is seen whether we examine the macrocosm or the microcosm. First, we will select some examples from the greater world or universe, and Astronomy affords some marked examples. Our moon revolves round our earth, the earth round the sun. The sun is moving at a rate of not less than 400,000 miles a day. He is thought to be moving round a star called Alcyone, in the constellation Pleiades. This journey of the sun would take $22\frac{1}{4}$ millions of years; or, if he is moving round the group of stars called the Pleiades, his year would be $27\frac{1}{2}$ millions of years. The proportion to our year of this solar year which I will consider—say 25 millions of years—is not far from a year to a second. The velocity of the sun in his gigantic orbit is about 780 millions of miles in a year. Light travels from the sun to our earth in little more than eight minutes. It would take nearly 1000 years to reach us from our sun's sun. It is possible that our sun's sun, Alcyone, with all his attendant planet-suns and their planets and satellites, may be himself revolving around some other centre.

As our sun, although he is himself a planet, is the centre of our system, it is important to have correct notions of him. I must detain you for a moment while I endeavour to answer the question "Why does the sun shine?" Sir John Herschel says, after enumerating various theories which have been advanced, that there remain only three possible sources of the heat of the sun—electricity, friction, and vital action. I will not detain you by enumerating the various theories; they most of them have this great defect—they attribute it to a temporary cause. But to my mind a cause must be found that will account for the sun and also nature having been the same for a time so long that it is impossible to conceive it, and that it will continue the same. But supposing we could account for the sun's force by combustion, or the friction of meteoric matter, or original heat, yet a still greater difficulty

occurs to account for what becomes of the immense force sent out from the sun. Those who have lived in tropical climates, where meat may be roasted on the rock, may form some idea of the power of the sun; and yet our earth only receives one two-thousand-millionth part of the force of the sun. Then recollect that our sun is only one among many thousands of suns, and by no means a large one. The star Sirius would make 200 or 300 of him.

As force is indestructible, what becomes of it? Professor Tyndall, I think, says that it passes into space and is lost. I think the Almighty Creator—I speak it with reverence—would not lose all this force; and that space, unless infinite, could not always hold it. It would become so full of force that it would be dangerous for us to travel through it. It would be as dangerous as for a man to walk through a powder magazine on lucifer matches. Judging from what I consider the plan of nature—namely, perpetual circular motion, I am convinced—and I have thought so these ten years—that the sun's force must circulate. Every particle of force that leaves the sun must sooner or later return to it again. It is not necessary that the force which leaves the sun should return to it in exactly the same form. It may leave the sun as light, or heat, or actinic force, and return to it as electricity, or as magnetism, to be absorbed in the sun's atmosphere, or rather, photosphere, and sent out again as gravitation, or light, or heat. There is through the solar system, and perhaps through the universe, a constant circulation of force as perfect and as uniform as the circulation of gross and ponderable matter. The sun is supposed to have a repellent as well as an attractive power. I have not had time to study his action; but the gaseous envelope of the sun is doubtless of a very complicated nature; it has doubtless many layers; it has many elements and metals in it; and I can conceive it probable that by the meeting of the electricity of the sun—and he is about a million times larger than our earth—and the electricity of space, may be formed a sort of electric light. So that the sun-force having been expelled as light and heat may travel some distance; on its way some of it may be expended in causing motion in the heavenly bodies, giving them light and heat and life; and, after a time, the force may return to the sun as electricity or magnetism, to be absorbed and again sent forth. There are several facts which favour this theory—namely, the violent storms in the sun; the immense velocity of some of the sun spots and clouds—35,000 miles in five minutes; the periodicity of the sun spots, there being an increase every eleven years; a coincidence or relation between storms in the sun and magnetic

storms on the earth. There is a periodicity in the pointing of the magnetic needle to the north, for a series of years pointing to the east of the north, and for another series to the west of the north. There are also daily magnetic waves on the earth.

If this view is correct—namely, that the sun is only the receiver and redistributor of force—it must alter our views regarding the sun and the planets. At one time the sun was considered to be a fixed star, and the planets were thought to wander round him. But now he is proved to be himself a planet revolving round some other sun; and in the same way I think he may not be the only source of force, but that all the planets which have a suitable photosphere may be—in, of course, a less degree—suns; that is, they may receive the force from space in one form and redistribute it in another. I think this is highly probable with regard to the larger planets, such as Jupiter, and the farther they are from our sun the more probable is it that they are suns to their satellites. And there are some stars the light from which never has and never will reach us—for from their immense distance their light is lost in transit. The light which is lost in coming to us probably becomes converted into some other form of force. When we survey the heavens and contemplate the number of the stars, we are lost in wonder; but when we consider that this visible universe is perhaps only a small part of the creation, that there are probably systems of stars whose light never can reach us because it will be absorbed or transmuted before it would reach us, our views of nature are greatly enlarged.

The uses of the sun-force are manifold. I will point out one probable use of it. You are doubtless all of you acquainted with that beautiful little instrument Crookes' radiometer. You know that a force coming from the sun and even from a small candle will make this instrument revolve provided the vacuum in which it is placed is almost as perfect as possible. Now the best vacuum that we can produce is probably most defective when compared with the vacuum of space. When I speak of the vacuum of space, of course I refer to the absence of ponderable matter, for of course space must be filled with imponderable matter or force. For if force extends from the sun to the earth, it must fill interplanetary space, and if so, interstellar space. Now if the force from a small candle will make the radiometer revolve, the immense power of sun-force may, in some way or other, make the heavenly bodies revolve, being, as they are, in a vacuum. Force may therefore be the cause of motion and also of gravitation. When electricity—a form of force—is made to pass round an iron bar, it converts it

into a magnet for a time, so that it causes it to attract other bodies. Force passing through all matter may therefore endow it with the principle that we call gravitation. All experiments made to explain the essence or cause of gravitation have failed, probably because we cannot produce any gravitation vacuum, so to speak—we cannot find any place where gravitation is not in which to make the experiment. I need not detain you by speaking of the other forms of force, as heat, light, electricity, magnetism, chemical action, vital action. There are probably also some forms of force derived from the sun, the nature of which we have not as yet even conjectured. Whether animal and vegetable life is a combination of the forms of force or a distinct force, we do not know; but whether we regard it as one or the other, we must look for it from the sun.

Comets have been hitherto regarded as mysterious and eccentric bodies, but they are so numerous that I cannot help thinking that they perform an important part in the plan of Nature. They do not seem to obey the same laws as planets; some comets are progressive and some retrograde, and when a comet appears for the first time you can never predict where it will appear next. What is a comet? Sir John Herschel thinks that it must be material, that is, have ponderable matter, because it reflects light which is polarised. But if it is material it must have very little matter in it. I have read that a man might carry the matter of a comet in his hand. At least the star Sirius was visible through the tail of a comet some thousands of miles thick, and comets have wandered among the satellites of Jupiter, and the satellites gave the comets the cut direct—they never moved out of their course in the least. Now if the comet had any weight or material importance, the moons of Jupiter must have taken some notice of it. I therefore consider that some comets are scarcely if at all material, and if there are any that cannot be classed under the term of ponderable matter, they must be classed under the term of imponderable matter or force. I should consider such comets therefore to be some form of force; and to represent the circulation of force through space, sometimes going to the sun, sometimes from the sun. I consider that, for the most part, this circulation of force is quite invisible to us, and that it is only when it catches up and carries with it some very, very thin nebulous matter, that it becomes visible to us; and we then call it a comet. I think that comets are intimately connected with the circulation of force, which circulation they may regulate and influence. It would be an interesting study to investigate how far comets travel before

they return. Some comets may only connect and form a bond of union between our solar system and those solar systems nearest to it, while other comets may connect constellations of solar systems, and others again unite constellations into nebulae, and nebulae may be united to other nebulae. If this is so, we need not wonder that some comets never return.

I fear that I have detained you too long with examples from the macrocosm, the greater universe, and I must come down to earth and find examples from the microcosm, or lesser world of man. With regard to my own body. I have breathed—that is, I have circulated air—about 500 millions of times in my life. My blood circulates in about a minute. Through the lungs it circulates five times as quickly. There are lesser circulations through the liver and other organs of my body. Nervous force travels in about 110 to 140 feet in a second. There is probably a constant circulation of nervous force. The now well-known law of reflex action seems to prove it. The question is often asked, “What is life?” There are three organs in the body so important that they are called “the tripod of life,”—the brain, the heart, the lungs. When the circulation of the blood or of the nervous force is arrested in either of these organs, death is the result. Life is coincident, and only compatible with circulation.

The circulation of matter is so tersely recorded by Pope that I may be excused for quoting him—

“See matter next, with various life endued,
Press to one centre still, the general good.
See dying vegetables life sustain,
See life dissolving vegetate again.
All forms that perish other forms supply,
(By turns we catch the vital breath, and die)
Like bubbles on the sea of matter born,
They rise, they break, and to that sea return.”

An instance of the circulation of human matter was brought to my notice the other day. On November 25th, 1877, I went to King's Langley church and saw all that was to be seen of the mortal remains of Edmund of Langley, fifth son of Edward the Third. I saw some bones of him and of his wife reverently placed in a wooden box. There was placed in a corner of the church a heap of dust that had been found in his tomb. Some of the matter of this dust, I could fancy to myself, alive and circulating on the trees in the Priory garden, and immortalised by Shakespeare, or running about the fields of Langley 500 years ago; and now, if it had not been for the pious care taken of it, it might again form

the food of plants and then of animals. While contemplating this scene, this quotation occurred to me—

“Imperial Cæsar, dead and turned to clay,
Might stop a hole to keep the wind away :
Oh ! that that earth which kept the world in awe,
Should patch a wall to expel the winter’s flaw.”

The same idea is expressed in the words “Dust thou art, and unto dust shalt thou return.”

The vegetable kingdom abounds in instances of the circulation of matter. I might quote examples “from the cedar of Lebanon to the hyssop on the wall.” I have often seen the circulation of chlorophyll in the *Anacharis Alsinastrum*, the American water-weed, and it forms a most beautiful object when viewed under the microscope. One great use of the vegetable kingdom seems to be to promote the circulation of matter. It takes from the mineral kingdom and builds matter into forms analogous to those found in the animal kingdom, as starch, sugar, albumen, etc. And then we have a class of microscopic plants, whose duty it is to reduce these forms back again to the mineral kingdom, which is effected by means of the vinous and the acetous fermentations. I allude to those forms of life, of which the yeast plant and some of the *Bacteria* are types, as a most interesting field for study. With regard to the oak, Dryden says :—

“Three centuries he grows, and three he stays
Supreme in state, and in three more decays.”

These words might be applied to man with a little alteration thus :—

“For thirty years he grows, thirty he stays
Supreme in state ; in thirty more decays.”

The circulation of water in the earth is very marked. The sun causes aqueous vapour to arise ; it forms clouds, and these again descend on the earth as rain, which finds its way to the sea by the rivers. Even in the ocean there is a marked circulation of water. The same takes place in the air. That storms travel in cyclones or circles is now a well-established fact. The Rev. James Clutterbuck informs me that Colonel Capper, of Bushey, was the first to indicate the circular motion of air in storms. The suspension of water in the air is somewhat remarkable when we consider how much heavier water is than air. Some have thought that water is sustained by means of electricity. As there is probably a circulation of electricity between the earth and the sun, it may account for the water being sustained in the air. If matter is so placed that it is free to move, it, as it were, spontaneously

assumes a vortex motion. This may be seen if you inject a coloured fluid into water; also if you watch the curling smoke from the mouth of a smoker, or the steam from a locomotive steam-engine.

Geology furnishes many examples of the circulation of matter. As you drive along the narrow lanes of Hertfordshire after the roads have been recently repaired, you will see the road-maker throw some large round stones on one side; they are smooth and water-worn, and if you break them you will find they are not composed of flint but of some rock that must have come from a distance. They are considered to show the action of ice, and that the period in which they were transported to Hertfordshire was one of extreme cold—in fact, a glacial period. At Bushey, a short distance from Watford, you will find the clay of the London Basin; and in this London Clay, numerous shells, Nautili and others, are found, which clearly indicate a hot climate. We have therefore within a short distance indications of a tropical and also of an arctic climate. We also find in the present day in the Arctic Regions, fossil remains of a vegetation that could not possibly have grown in the climate at present existing there. If this only occurred once, we might suppose that the earth was formerly much hotter than it is now, and that it is gradually cooling. But we find, in fact, a succession of hot and of cold climates, and the climate of Watford is much warmer now than it was when the boulders were brought here on ice; and I think that the sun and the earth cannot be gradually cooling, and may be getting hotter.

I will not detain you by enumerating the numerous theories which have been advanced to account for the changes of climate in the same places on the earth. Our late President, Mr. John Evans, has propounded a theory before the Royal Society, which he has also brought forward in his address as President of the Geological Society. Several theories that I have heard of to account for change of climate have this defect—they are occasional and extraordinary, and might possibly account for one change. But we have to account for an alternation of hot and of cold periods. Mr. James Geikie says in his last work, ‘The Great Ice Age,’ “All the geological formations, except the Laurentian, have been considered to yield evidence, more or less satisfactory, of the former action of ice.” Therefore we have to account for a series of alternating geological periods of summer and winter on the earth.

When we call the last glacial period the Great Ice Age, we do not infer that it is any greater than the ice periods which preceded it, only that, being the last, the evidence of it is more marked.

The marks of former ice action in older formations would of course be more or less obliterated by age and geological changes. It seems to me that the solution of the cause of the fact of our earth having passed through a succession of climates alternately hot and cold must be sought for in the science of Astronomy. Many astronomers do not think that the precession of the equinoxes is enough to account for it. Mr. Croll, in his work 'Climate and Time,' says that he thinks it is. I think it highly probable, judging by analogy, that our sun has a climate—that he has not uniformly the same temperature. Our sun travels round his sun in a stellar year of about twenty-five millions of years. As our earth has changes of temperature in its year, so may the sun have changes of temperature in his year. If our sun's sun is powerful enough to compel the solar system to revolve around him, he may be powerful enough to influence our sun, and with him the whole solar system, in other ways. I consider it possible that our sun may have spring, summer, autumn, and winter in a period of about twenty-five millions of years, or at least, that he does not always have the same climate. I do not mean to infer that our sun derives light and heat from his sun, *as* light and heat, for the light from Aleyone is very little, and the heat imperceptible; but he evidently influences our sun by the force of gravitation, or else it would not revolve round him. And if he can supply the force of gravitation, he can supply other forms of force, which may be utilised by our sun and converted into light and heat. If this theory is true, we might be able to solve that very interesting question, the age of the earth. To use a common phrase, "every schoolboy knows" that if you make a transverse section of an exogenous tree, as an oak, you will find the wood arranged in a series of rings or layers. Now each ring of wood represents a year of growth; so we have only to count the number of rings and we have the age of the tree. In a precisely similar manner, in order to ascertain the age of the earth, we must make a perpendicular section of the earth, and count the number of ice ages. Each ice age may represent a solar winter, that is, a year of twenty-five millions of years. Suppose we find evidence of 100 glacial periods, we should estimate the age of the earth at about 2,500 millions of years. Of course the calculation is only suggestive or approximate, for the data of my calculation may be incorrect. Astronomers may find that the sun's year is more, or that it is less than twenty-five millions of years; or geologists may find evidence of more or of less than 100 glacial periods; or the sun may have two or more cold periods in his year, or he may have

only a severe winter, as we do, in a cycle of years. I only wish to indicate the principle. It would be very interesting for geologists to study our sun's climate, as revealed in the geological records of the earth, and not only his winters, but also his summers—his hot periods. I do not pretend to be a geologist, but when I see a coal fire I cannot help speculating on the number of sun's summers that coal has experienced to be changed from a mass of vegetable fibre to a mass almost mineral in structure. I can imagine one summer of the sun drying up the moisture from the peaty mass, and others distilling and condensing in nature's retort those oils which our enterprising American cousins tap with such profit. The evidence of hot seasons is perhaps less marked than the evidence of cold seasons, because no boulders are brought from a distance and left as evidence. Yet I think that the sun's hot periods may have still left geological evidence of their existence which may be well worthy of investigation. Last year Mr. John Evans took us to see the Rough Down chalk-pit at Boxmoor, and he very particularly pointed out to us some veins of what is called the Chalk Rock; it was strong and much harder and denser than the other chalk, and I can easily imagine that great heat might convert it into marble. We may therefore not only study the age of the earth from its sun's winter, but also from its summer. If the science of Palæontology were more perfect, it would doubtless afford evidence of an alternate series of hot and cold periods on the earth in the same place, and I think the kind of animals would be found to correspond with the climate of the sun and therefore of the earth.

When I spoke of the age of the earth, I should have been more correct if I had said the age of the crust of the earth, for the age of the earth and the age of the crust of the earth are quite different. The age of the crust of the earth, great as it is, must be considered as ephemeral compared with the age of the earth itself. For instance, if I say I am 50 years old, I do not mean to say that the atoms of which my body is composed are only 50 years old, or that if an oak is 500 years old, the carbon of which it is in a great measure composed is only 500 years old. The matter in my body may be eternal—at least, it has doubtless animated thousands of animals and plants before I became seized of it for my temporary use, and doubtless when I have done with it other animals and plants will be animated by it. I may illustrate this by mentioning what is taking place at the present moment in Watford and the Atlantic. Huxley says, "I have ventured to speak of the Atlantic mud as modern chalk." Investigations have demonstrated the

existence, at great depths in the ocean, of living animals, in some cases identical with, in others very similar to, those which are found fossilised in the White Chalk. The Rev. J. C. Clutterbuck tells me he had some of the Atlantic mud given him, brought up by the *Challenger*. He analysed it and found it identical in composition with the Lower Chalk of Hertfordshire. Now the *Globigerinae*, and other animals which are now making chalk at the bottom of the Atlantic for future ages, must derive the lime from the water, and the lime of the ocean is supplied by the lime in the rivers.

The streams of Hertfordshire take tons of lime daily to the sea to make chalk. Each cubic foot of water from the river Gade at Watford, it is calculated, contains 100 grains of chalk. Now when the Atlantic becomes dry land, which it may do in a few years—solar years,—the future natives of the Atlantic may speculate on the age of their chalk as we do of our chalk, and say how old it is, little dreaming that some of the chalk existed previously as chalk in Hertfordshire, as we do not dream of our chalk having existed in some previous formation. Most of our geological formations are sedimentary, and the matter of which they are composed must have existed before; and besides this, to each sedimentary stratum there must have been a dry land stratum which is not represented. This may be called an ante-period. Therefore if astronomy and geology combined enable us to estimate the age of the crust of the earth, they can never give us any evidence of the age of the matter of which the earth is composed.

I cannot bring forward the doctrine of evolution in proof of my theory that the plan of nature is perpetual circular motion, because the doctrines of Darwin are not yet quite accepted; yet as they are believed in by some of our most profound thinkers, and by men most able to form an opinion, I think Darwinism will be taken for granted in the not very distant future, in the same way as we now take for granted Newton's theory of gravitation and the undulatory theory of light. Haeckel says that in the future, Darwin's statue—he is a member of our Society—will be raised higher in the temple of fame than that of Newton; that whereas Newton introduced order into the world of matter, Darwin has introduced order into the world of life—a much more difficult undertaking. Darwinism would only half support my theory, for if the higher animals are evolved from the lower, it would only account for half a circle. To accord with my theory, we must suppose that there is not only a doctrine of evolution, but that there is also, if I may coin a word, a doctrine of devolution—not

only that a lower form ascends to a higher, but when the highest form of an animal is reached to which its anatomical structure is capable, that after a time it descends to a lower type, again to ascend so as to make the circle complete. As I cannot think that matter can travel through infinite space—through eternity—in a straight line, so I cannot think animals can continue to be evolved or developed for ever—they must at some time attain perfection, and then retrograde. Evolution is not necessarily exaltation. Human affairs seem to travel in a circle, for nations, like men, have their infancy, childhood, manhood, and old age.

I must now bring my remarks to a conclusion. In a few words I believe that “In the beginning God created the heavens and the earth;” that is, that He created force and matter, and endowed force with many wonderful properties, one of the most important of which properties is that it is the cause of perpetual circular motion in all matter, and that this law extends through the animal, the vegetable, and the mineral kingdoms. Time has not allowed me to bring forward many instances or arguments in favour of this theory, and my remarks must appear to you incomplete. Most likely I have not told you anything new; but if I have put old facts in a new form; if I have thrown out suggestions for thought or for investigation; if I have induced you to contemplate and to study the marvellous works of the great Architect of the Universe; and above all, if I have induced you to exclaim, “How manifold are Thy works, in wisdom hast Thou made them all; the earth is full of Thy riches,” I shall be satisfied.

8.—ON BRITISH BUTTERFLIES.

By the Rev. C. M. PERKINS, M.A.

[Read 14th March, 1878.]

I HAVE been requested more than once by our Secretary to prepare some paper on the subject of Entomology to read before this Society; but I have hitherto refrained, for the reason that I feel my own knowledge to be so slight that I have little hope either of saying anything that is not already known, or even of putting in an interesting form to the majority of my audience the little knowledge that I may possess. Had I been able to give this subject the time I had hoped when I first joined this Society, I should no doubt have been able to give you a far fuller list of places where the various lepidopterous insects might be found in this county; but unfortunately, though my love for this branch of science has not at all waned with time, yet I find years as they go on leave me less opportunity of indulging my fancy and gratifying my desires in this respect. I shall therefore first ask the indulgence of the more learned on the ground that I reluctantly read this paper before them, while I shall be pleased if I can add one iota of knowledge or implant any love for this engaging science in any of our younger friends.

From the wide range of Entomology I have chosen the "British Butterflies" as my subject this evening, and will speak briefly of each species with the view principally of pointing out, to the as yet inexperienced collector, their favourite haunts, and indicating localities in this neighbourhood where I have met with them.

But, firstly, let me say that butterflies belong to the order of insects called Lepidoptera, that they receive this title (which is framed from two Greek words, meaning scales and wings) from the fact that their wing-frames are covered with scales fitting over each other, as the tiles of a roof; and these scales, which amount in number to hundreds of thousands on every butterfly, impart to it that striking beauty which captivates alike the eye of youth and age, for the very infant will stretch out his tiny hands to possess it, and the adult, who is ever seeking out the beautiful, not unfrequently places it in the foreground of some splendid work of art which he copies from nature. Further, amongst the Lepidoptera the butterfly belongs to that sub-division termed in science Rhopalocera, another compound Greek word meaning club-horned, because one of the principal distinctions between the butterfly and moth is the little knob which may be noticed at the tip of the antennæ or horns of the former.

Many people imagine that the number of species of butterflies in Great Britain is great; but this is an error, which arises from the fact of their mistaking a number of the brighter moths which fly by day for them, for, while the species of moths approach nearly 2,000, the butterflies on this island do not amount to

seventy. Mr. Stainton, whose classification I shall follow, reckons their number at 66, while some other eminent entomologists make the number rather greater by inserting one or two species which may have been found by accident, perhaps brought over from the Continent in the pupa state with some botanical specimen, or by counting as separate species certain varieties of species which are not unfrequently taken.

I feel it can hardly be necessary to say that the butterfly is not the only form in which the insect so named exists, for this fact is generally learnt at a very early age, through the not uncommon practice of allowing our children to rear silkworms, and it is quite necessary to the accurate knowledge of Lepidoptera to study the insect in all its phases. It may seem to some hardly credible, but the future butterfly may be known from the tiny egg more certainly than many of our birds by the same means, for the egg of the insect has far greater distinctions, taking the most wonderful forms and appearances, and no more beautiful objects can be found for the microscope than several of the butterflies' eggs. But to know them in the larva or caterpillar state is still more necessary, for by this chiefly we classify them, which we cannot do from their eggs, for two butterflies closely allied will differ very materially in the egg state. Again, the pupa or chrysalis state is also well worthy of notice, and it is most curious to observe how the whole of one family will invariably suspend themselves by the tail, hanging head downwards, thus to remain till the butterfly emerges; and how another, in addition to the fastening at the tail, will tie a silken cord round the body, and thus suspend and support themselves in an opposite direction, viz. head uppermost to a twig or wall; and how a third will invariably bury or cover themselves up in a leaf, or hide beneath the bark of a tree, thus concealing themselves from view.

The 66 butterflies are classed under five families, respectively termed in science, Papilionidæ, Nymphalidæ, Erycinidæ, Lycaenidæ, and Hesperidæ.

The Papilionidæ are readily distinguished from the other families in the larva state by being vermiform or worm-shaped, and in the perfect or butterfly state they have a ground colour of their own, varying from white to brilliant saffron yellow. Many of this family are well known even to the unobservant, for it is next to impossible not to notice in the first bright days of the year, long before the leaves come out and nature generally revives, the beautiful primrose-coloured butterfly flitting down some woodland path or along some sunny railway bank, or perhaps across our garden, where we would fain have it stop that we might feast our eyes a little space, but on it goes and seldom seems to rest in these early days; and then tell me which of you in your younger days has not chased the cabbage white about the garden, much to the detriment of your hat, particularly if it happened to be made of straw. I should be sorry, if I knew the number, to confess how many I have spoilt, but of this one thing I am certain, that had

my love of sport in these early days, which gradually developed into a love of science, not exceeded the fear of being scolded, my chance of ever writing a paper on the subject of butterflies had been very slight indeed. Most of this first family are very strong on the wing, and require some exertion in catching, and many a hard straight-ahead chase have I had after the clouded yellow, generally to be beaten in the long run—but I must not describe my chases, or I shall soon weary you with the length of them; but rather, as I proposed, will now give you some account of each of our British species.

Of this family I must take *Papilio Machaon* first, a truly superb insect, having rich black, blue, and red markings on a cream yellow ground, with two long pointed spikes projecting from the lower wings, whence we give it in English the name of swallow-tail. This insect in its natural freedom I have not known, but have bred specimens sent me from the fens of Cambridgeshire, which are its natural haunts. Though said to be common in the fenny districts, where its food plant, *Peucedanum palustre*, grows luxuriantly, and reported to be taken not unfrequently in places near which are no large fens, I think it very unlikely we shall ever meet with it, unless we make a trip on purpose to its feeding grounds. So strong on the wing is this insect, that I have been told it not unfrequently soars like the lark to a very considerable height, and this in my opinion may well account for the specimens reported to be taken in strange localities, for with its own natural strength, aided too by wings more powerful than its own, it may be borne away with a sudden gale in its heavenward flight many a long mile from its native home. Next in order comes the sulphur or brimstone butterfly already alluded to, *Gonepteryx Rhamni*; common wherever I have been through the southern counties, and abundant in this neighbourhood, both in spring and autumn, I shall at once dismiss it, only remarking further that I believe I have seen it flying every month through the year. *Cobias Edusa*, the clouded yellow, follows,—a glorious insect, having a rich broad band of black to its saffron wings; more often seen than caught; indeed, you may congratulate yourself if you net it, unless you happen to meet with it in a field of blossoming clover. And while speaking of this insect I will mention a phenomenon which I believe has never yet been satisfactorily explained, which is, that some butterflies appear in certain years by thousands in places where, for many years preceding, and the year or years immediately following this profusion, not one has been observed. I collected butterflies in the neighbourhood of Wotton-under-Edge, a town in Gloucestershire, for some dozen years before 1858, and I knew an old collector there, who had collected for very many years before I began, yet neither of us had ever seen there one single specimen of the clouded yellow, until 1858, when they showed themselves in hundreds on all sides of the town, and enabled us to obtain plenty for ourselves and more to give away. Last year the same phenomenon occurred again. Their name might be legion, yet in

the mean time—19 years—I do not think I have seen a single specimen, though I have visited the locality every intervening season. They were quite as common here; instead of supplying a cabinet, one might have filled a small basket, and not a few of the scarcer variety, *Helice*, were among them. Let not the new collector despair then if he fails to catch this insect his first year or so, for some day after waiting he may expect to catch as many as he pleases. Somewhat like, but a little smaller and of a paler colour, and, in my experience, far rarer, is *Colias Hyale*, the pale clouded yellow. My second son caught one in the playground adjoining my school, in October, 1875, and I have seen one or two other specimens taken near St. Albans, and so I doubt not but that every one who seeks it in clover or lucerne fields in the autumn, in this neighbourhood, would find it, if not in his first year, yet early in his entomological life. The next species will be *Aporia Cratægi*, the black-veined white, easily distinguished from the other whites by being semi-transparent and showing distinct black veins upon the upper side of the wings. This I have only taken once, in Dean Forest; but as its food plant, the hawthorn, is so common, and it appears to be a widespread insect, I cannot be surprised if others more fortunate than myself have proved it a native of this county. For some unknown cause it seems to be disappearing from many places where it was formerly abundant, which certainly cannot be laid to the destruction of its food plant, as is the case with some of our Lepidoptera.

Of the next three butterflies—*Pieris Brassicæ*, the large cabbage white; *Pieris Rapæ*, the small white; and *Pieris Napi*, the green-veined white—I shall say nothing, as they are so well known and only too abundant in every garden, ever causing trouble to the lady with her bed of mignonette, or to the cook in the dressing of her vegetables; but will pass on to *Pieris Daphnidice*, the Bath white. This is the first great rarity, and fortunate is the person who takes one on English soil, for while a shilling will purchase a Continental one, you may bid at a sale a sovereign in vain for a proved British specimen. A few, beyond question, have been taken in this country, but great doubt exists whether they were raised from the egg laid on English soil, or have been blown across the Channel from the coast of France, where they abound. In 1855, I was spending a short time in Normandy, and in visiting an old Roman camp a short distance out of the town of Dieppe, I saw them flying in hundreds over the rough long grass, and without difficulty secured half a dozen good specimens, but having no entomological apparatus with me, unfortunately I spoilt them all before reaching home. I can give you no clue for obtaining this insect except to keep your eyes well open when visiting the south coast, and even then I fear you will be disappointed if you expect to catch it. The next in order is *Anthocharis Cardamines*, the orange-tip. This you will be sure of meeting with every spring, flitting up and down the hedgerows in our lanes and fields at a tolerably brisk pace, and dodging about so that you may strike once and again before you

net it. And here one caution for beginners, for often has it been announced in the Natural History periodicals by the tyro that he has taken *Daphidice*, and doubtless his heart has swollen with delight at obtaining this prize, coveted, he knows by thousands, and with confidence he sends it to be inspected by some veteran entomologist, when lo! to his mortification, it is returned and labelled, not *Daphidice* but *Cardamines* (female); for this modest little lady throws aside the gaudy yellow tunic her gay husband wears, and shows upon the upper wings but a plain white dress quietly trimmed with black, though she has a beautiful under petticoat of speckled green. Look well at specimens then before you proclaim the capture of a Bath white, lest you display with it your own ignorance, by the exhibition only of the female orange-tip. The last of this family is *Leucophasia Sinapis*, the wood white, a very delicate little butterfly with attenuated body, flying much more gently than the rest, and looking like an invalid. Resembling somewhat the female orange-tip, it may yet be at once distinguished, for it lacks the delicate green pencilling on the under-side, as well as a black central spot on the upper wing which the former possesses. I have found it in the woods in different parts of Gloucestershire the first and second week in August, always in the more entangled part, threading its way through very slowly, so that it is easy to capture if you can only keep your net from catching in the trees. I think it should be found here, as its food plant is abundant, but cannot remember having seen it.

This brings me to the second family, the Nymphalidæ. These may be distinguished at once from the others by having only four legs in place of six, at least only four worthy the name and which they use for walking, the other two being only partially developed. Many of these are as well known as some I have noted as common in the first family, for I am sure every one must know the peacock, the red admiral, and the common tortoiseshell, and must have often admired them basking in the sun on some low flower or the bare ground; but I will take them in order as before, that you may know where to look for them should you require to cultivate their acquaintance more closely. Following Mr. Stainton's list, we have first *Arge Galathea*, the marbled white, a very striking and pretty insect, its wings having a creamy yellow ground, marbled over with about an equal quantity of black. You must look for it on high ground. I have found it very abundant high up on the slopes and tops of the Cotswold Hills, but can only record one specimen in this county, which I saw two years ago flying across the playground of the Orphan Asylum in this town. The next two species are universally common; they are named respectively *Lasiommata Aegeria*, the speckled wood, and *Lasiommata Megara*, the wall, the former a rich dark brown (when taken in good condition) with several yellowish spots both in the upper and lower wings, eight of which inclose as many black ones with white again inside. This insect loves to sport in damp and shady places, such as overgrown paths in woods, and narrow deep-cut lanes.

The second is the very opposite in habit, and you may see it in advanced spring, and again in autumn, sunning itself upon a scorching wall, or flying deftly along any warm bank skirting a dusty road. Its colour is tawny fulvous, pencilled over with dark brown wavy bands. *Hipparchia Semele*, the grayling, is my next, a rather larger insect, somewhat similar in colour to the last, but not so bright, and the markings different enough to distinguish at the first glance, though not so easy briefly to describe. This insect loves the sides of high, steep hills where loose stones abound, which makes its pursuit extremely difficult. I am told it may be taken on the Harpenden road, near Childwick. I have not seen it there myself, but I have found it in August in most places where I have been on high, rough slopes of hills. Its congener, *Hipparchia Janira*, the meadow brown, I shall dismiss at once, only saying it is that rather dull brown butterfly which swarms over every hayfield. *Hipparchia Tithonus*, the gatekeeper, is likewise a common insect, somewhat smaller and a good deal brighter than the last, yet bearing a great family resemblance. It may be seen in August along every dusty roadside, skipping up and down over the brambles, and evidently thinking the taller the hedge the more delightful it is. *Hipparchia Hyperanthus*, the ringlet, a very dark brown, approaching black, with underside of lighter shade, on which may be seen some exceedingly pretty white-centred black spots in yellow rings round the hind margin, is not uncommon in woods at midsummer, and may be obtained in this neighbourhood. Then we come to some northern insects, *Erebia Blandina*, the northern brown, and *Erebia Cassiope*, the small ringlet, which we are not likely to meet with here, so I shall only say that whoever wants to catch them with his own hands should not forget, if he visits the Lake District between the end of June and beginning of August, to take his net and look for them half way up the hills there, and he will most likely secure them both. The next on my list, *Canonympha Daraus*, the marsh ringlet, is also a northern species, which frequents mossy bogs, plentiful generally wherever it occurs, and may be taken in the Lake District about the same time as the last-mentioned insects. The colour is buff in the females, but the males are darker and very similar to, though larger than, my next, *Canonympha Pamphilus*, which is common on every heath, and may be caught plentifully upon the green near Bricket Wood station all through the summer months.

We now come to some glorious insects, larger in size and brighter in colour than those lately noticed, every one of which the collector is eager to catch, as they make a great show in his cabinet. *Limnitis Sybilla*, the white admiral, said to be the most graceful in flight of all, is found in many woods in the south, feeding in the larva state upon honeysuckle. Many a mile have I walked with the hope of catching this on the wing, and many a honeysuckle have I searched in woods where I think it ought to be, for the green caterpillar with rust-coloured spines, but in

vain. My eyes have never yet been gladdened with the sight of it alive, and I have to content myself with admiring two specimens which were given me. These were caught, I believe, in Essex, and I should not be surprised to hear that this county also produces it. *Apatura Iris*, the purple emperor, comes next in order, and with most collectors first in esteem of all the butterflies. The beautiful purple with which his majesty is clothed delights the eye and makes him a deserved favourite. But few who are not entomologists know him while alive, for he is not one to intrude himself upon the eye like the gaudy peacock, which seems to delight in flaunting the large purple eyes in its wings before you on any low flower, but you must look aloft for his royal highness, and only then in the secluded park or dense forest. Here on some isolated oak he sets his throne, on the very top, ever and anon dashing with bold flight into the air above, it may be to engage in fierce contest with some brother emperor, who has ventured too near to his domains, perhaps to woo some lady fair he wishes to make his empress. You may see him thus by searching for him, but how to catch him is another thing. No net will reach him, and you may wait and wait for hours, yet he won't come down to give you a chance of netting him. What is to be done? You can see at a glance, even could you climb the tree, you would have little chance of netting him, he settles in such awkward places on the foliage right outside. Some persons tell us that when you have discovered his whereabouts, you should carry there the nastiest thing that you can find, say some filthy carrion, and place it near his seat, for that he will demean himself so far as to make this the object of his depraved taste, and thus lowering himself he is easily captured. This rests on good authority, but I have never tried it myself, so cannot say that it is a certain plan. It may have succeeded once or twice, but possibly may not always. Another plan, and likely to be successful, is to search the shallows well in the neighbourhood of his haunts, and look for the green larvæ with yellow stripes, and thus rear him in confinement. The only place I have yet taken him is in the Forest of Dean, where he was far from common in my experience, but as several contiguous counties to our own are said to produce him, we ought, I think, to find him here.

I pass on to *Cynthia Cardui*, the painted lady, with which most of you must be familiar. Ought I to say I am sorry that painted ladies are so common as they are, and join my voice with those who would condemn Madame Rachel and Co. in their art of beautifying? Be that as it may, you will find them in almost every cornfield of this neighbourhood in spring and autumn, swiftly flying up and down that path which may lead you through, alighting every few minutes on or near the same spot. Very wary is my lady, and hard indeed to catch; but wait for her return after you have struck at her in vain, perhaps a dozen times, and most likely in the end your patience will be rewarded. It is little use giving chase to her, for she is as fleet as the wind itself.

Vanessa Atalanta, the red admiral, is the next, one of my favourites, for its boldness and familiarity. Though strong on the wing as any, it is easily caught, for it sits upon the leaf or trunk of the tree where it has just settled in the sun with such confidence that you may often place your net close against it without disturbing it. I remember well one once flying on my hand and basking there as I held it in the sun for a considerable time, and though I blew it off several times, it returned again and again. I need not describe its colour, for it is so common that it is well known; so now to its congener, *Vanessa Io*, the peacock, of which I shall only say that you cannot fail to see it every season, and it will be your own fault, should you require it, if you do not get it. And this brings me to a very beautiful insect of far rarer occurrence amongst us, *Vanessa Antiopa*, the Camberwell beauty, of large size, having chocolate-coloured wings with purple blushing through, and edged with a broad creamy white band. This insect, as I have said of *Colias Edusa*, is very irregular in its appearance, some years being almost common and putting in an appearance far and wide. In 1789 and 1790 it was seen in great numbers together in Surrey. In 1820 it is reported of it that great numbers strewed the shore at Seaton Carew, in Durham, alive and dead, from which time till 1858 it has never been observed in any number, but in the last-mentioned year I find in my own notes that it was captured in considerable quantities again. It may be interesting to some to know that Mr. Humphreys, an admirable authority, saw unmistakably a specimen of this insect on the road between this town and St. Albans on the 12th September, 1855, but through want of apparatus and the impatience of a travelling companion, he failed to catch it. *Vanessa polychloros* and *Vanessa Urticeæ*, the great and little tortoise-shells, are much alike,—the smaller one common everywhere, the larger not uncommon in this neighbourhood, should both be readily obtained. If you know of any elm trees which overhang a wall or wooden paling, you may almost invariably find the chrysalis of the larger one suspended to the coping by the tail, about midsummer, which is the best way of obtaining fine specimens; but be careful how you pull it off, for the silken threads which suspend it are so strong, that the pupa is often injured by the act, unless very carefully performed. *Grapta C. album*, the comma, I now arrive at. It derives its name from a silver C-like mark upon the underside of the lower wings. The wings of this insect are peculiar for their deep irregular indentations, which to the inexperienced eye give it a ragged appearance, until more closely observed. This insect is sufficiently common in Gloucestershire, on either side of the Severn, and I found a favourite resting-place, some hexagon netting with which we used to protect our wall fruit. This against a west wall on a fine afternoon in July would almost always produce a specimen, if required. I have never seen it here, but report says it used to be very common round London, so it is not, I think, altogether vain to expect it at this short distance from our overgrown metropolis.

We come now to the Fritillaries, a goodly company of nine, very showy insects of rich fulvous colour, beautifully spotted and marked with black. These are all almost more beautiful on the underside, some having bright silvery spots to heighten their splendour, and in those species where the silver is absent, the blending of colours on a pale straw ground is even yet more beautiful. *Argynnis Paphia*, the silver-washed fritillary, the largest, is common in most woods in the southern counties, and may be found in July flying with good speed over those parts which have recently been cut down. *Argynnis Adippe*, the high brown fritillary, may often be caught at the same time and place, but it is not quite so common, and makes its first appearance a week or so earlier, and disappears much sooner. *Argynnis Aglaia*, the dark green fritillary, is so like the last that it can only be distinguished by some slight markings on the underside. Yet it is different in habit, and you must not look for this inside the woods, but on hills outside, where from its rapid flight, and there being no impediments, it will give you active employment to catch a dozen even where it is most abundant. *Paphia*, I am told, is common in woods near St. Albans, but I am sorry to say I can give no certain information about the two others occurring in these parts, as I have never been in this county when they should be flying, but I have no doubt they may all be obtained at the proper season, within a few miles of this town. A fine race I had this summer over Breakheart Hill, near Dursley, in getting some specimens of *Aglaia* for my children: a hill, whose sides are excessively steep, and which gained its name, so tradition says, from a man who, in endeavouring to win a bet that he would carry a chain to which a link was added at every step he took, fell dead of a broken heart before he reached the top. *Argynnis Lathonia*, the Queen of Spain fritillary, is another great rarity. It has been taken in woods, and lanes near woods, in the South of England, nearly every year, but I think few people have captured it otherwise than singly. It is rather smaller than the three before mentioned, and is at once distinguished by the larger and brighter silver spots. Kent appears to be its favourite county, and September its favourite month. Then next in order are the two pearl-bordered fritillaries, *Argynnis Selene* and *Euphrosyne*, which may be taken in our neighbouring woods in the months of May and June, *Selene* being a little later in appearing and disappearing than its congener. It is astonishing how suddenly these go to bed, and disappear temporarily with the sunshine. These last six are all bedecked with silver spots on the underwings, which serve to distinguish them from the next three, the names of which are: *Melitæa Cinxia*, the Granville fritillary, abundant in the Isle of Wight, but rarely found elsewhere; *Melitæa Athalia*, the heath, is met with in woods on either side of our county, in Essex and Buckinghamshire, and so I hope between, but I can give no locality; and *Melitæa Artemis*, the greasy fritillary, about the same time, flying heavily over damp meadows, is much more common in the same counties. With these I finish the second family, only adding that several of these fritil-

laries, which abound wherever they do occur at all, confine themselves to a small spot of ground, so that, while one person may collect a hundred in a single wood, another may miss the spot and walk for hours, perhaps within a short distance of their haunt, and never catch a single specimen. I have done so in seeking *Artemis*, which a neighbour of mine, who refused to disclose his hunting ground, though he would readily give away specimens, could take by hundreds.

Of the third family, Erycinidæ, but one species honours our country, or even Europe, so it will not detain us long. In this family the males resemble the last in having only four good legs, though the females possess the full complement of six. The larvæ are onisciform, *i.e.* of the shape of the woodlouse. The sole representative, *Nemeobius Lucina*, the Duke of Burgundy, in the butterfly state is very similar to the true fritillaries we have just been considering, though in size very far inferior. It is early in appearance, and may be looked for in woods after the first week of May wherever any open space allows a brilliant sunshine. I have not caught it in this county yet, but found it common in Gloucestershire and Oxfordshire, and hear that it may be secured on Berkhamstead Common.

And so to the fourth family, the Lycænidæ, which, like the last, are onisciform in the larva state, but males and females alike have six perfect legs. Of *Thecla Betulæ*, the brown hairstreak, the first in order, I can say little from my own knowledge, having only seen it once alive, and that in Gloucestershire, but it seems to occur in most of the southern and midland counties, and to be common in Epping Forest, so we may reasonably expect to see it here. It is a good-sized insect of a dark brown colour, with more or less yellow on its fore-wings, varying with its sex, and two or three spots of the same colour at the bottom of the lower wings. August is its time for flying, and tall hedgerows the best place to look for it. *Thecla Pruni*, the dark hairstreak, is a smaller insect much resembling the male of the latter. It is far more uncommon, appearing earlier in the year, and hardly ever taken out of the county of Huntingdon. *Thecla W. album*, the black hairstreak, so like the preceding that for some time they were not recognised as separate species, is a little darker in colour on the upper side, and may be distinguished by the underside having a zigzag white line forming a W near the anal angle. I have taken this insect in Gloucestershire, just outside Dean Forest, in gardens and sheltered valleys, but never more than one at a time, so that I think it must be rare there. July is the proper month to find it flying, and as it has been taken in counties contiguous to this, it is not improbable that Hertfordshire produces it as well. *Thecla Quercus*, the purple hairstreak, so named from a purple blush overspreading the dark ground colour of its wings, much plainer in the female, and confined to a dash in the fore-wings, is a common butterfly, and may be seen, if not caught, in Bricket Wood any sunny day at the beginning of August. It is a high flyer, and therefore hard to

catch, but by waiting in some portion of the wood which has been lately cut down, near some taller oaks from which it will occasionally descend, you will seldom have to go away unrewarded. *Thecla Rubi*, the green hairstreak, is the commonest of all this class. It is of a brown colour inclining to olive on the upper side and a rich green beneath. This you should not fail to find on the outskirts of Bricket Wood at the end of May, though from its colour resembling the foliage on which it settles it often escapes observation. *Ceanonympha Phleas*, the small copper, next on the list, is very common here. Look on any rough piece of ground (an unused quarry, where wild flowers are suffered to grow unmolested, is a very favourite place for this and many of this family), and you can scarcely fail to find it. The more open paths through Bricket Wood will supply your collection any bright, sunshining day in August. *Ceanonympha dispar*, the large copper, seems to be no longer known in the British Isles, though still retained on the list. A lady friend of mine has a goodly number, which her son (now dead) caught in Cambridgeshire some 40 years ago, and with the exception of this gentleman I know of no other I have spoken with who has seen this insect flying. The latest capture I have seen recorded was in the county of Huntingdon about 30 years ago. *Ceanonympha Chryseis* is the next, of which I shall only say that much doubt exists whether it should be reputed a British insect at all.

We will pass on, therefore, to the sub-family of blues. *Polyommatus Argiolus*, the azure blue, feeds in the caterpillar state upon blossoms of holly, and if the number of insects was at all proportionate to the quantity of its food, this insect should be far more common here than in Gloucestershire, where I used to see it in great numbers early and late every season; but here I have but seldom met with it. Laurel I have found to be its favourite resting-place, and I suspect the larva often feeds on the blossoms of this shrub. The female is distinguished by a broad black band on the margin of the fore-wings. *Polyommatus Alsus*, the Bedford blue, is our smallest butterfly, and only faintly shows blue over its dull brown dress. I think it is an insect more common than collectors give it credit for, but it is decidedly local and not very quickly observed. I have found it in sheltered places on the Oolite in Gloucestershire in the month of June, settling more often on brambles than on anything else. I am sorry I cannot give any information concerning it in this county. *Polyommatus Acis*, the mazarine blue, is a rare butterfly, and seems to be disappearing from places where it was once common. It is found in meadows in a few of the midland counties, and used to be taken on my old hunting ground in Gloucestershire. Specimens taken there are still preserved, but I have never had the good fortune to meet with it, and know of no capture there in recent years, though in the neighbourhood of Cheltenham, some twenty miles away, it is still taken. *Polyommatus Arion*, the large blue, is another rarity. The same cabinet alluded to in my last contains specimens of this insect also, taken near the same place,

and I find Buckinghamshire and Bedfordshire both produce it, and as it is a lover of a chalk soil, it is not unlikely that those who search for it in the end of July on high broken ground may be successful in finding it here. *Polyommatus Corydon*, a pretty silvery blue, I have found very common at the end of July and beginning of August on chalk hills. It was flying last year in such profusion upon the hills in Gloucestershire that it would not have required the least exertion to catch a hundred in a few minutes.

Polyommatus Adonis, the Clifden blue, is the brightest of all the blues, with a slight silvery sheen over the deep colour. It is not uncommon on the Southern Coast upon the chalk hills, and I have taken it now and again upon the Cotswold Hills, but never in any quantity. About midsummer it flies, and may be distinguished at a glance through its brilliant colour even while flying. *Polyommatus Alexis*, the common blue, is known to all, being bright enough to attract attention. It may be observed on almost every lawn, and requires no looking after. *Polyommatus Ægon*, the silver studded blue, has also a very wide range, and may be taken in almost every English county in July. Being very like the common blue in habit and appearance, no doubt it is often passed over, yet a glance at the underside will show those pretty silvery blue spots which give it its English name. *Polyommatus Aegestis*, though classed with the blues, is a brown insect above, with a band of orange spots along the margin of its wings, and may be taken early and late in the season on almost every heath. You may obtain it flying over the green common near Bricket Wood station, should you require it. *Polyommatus Artaxerxes*, the Scotch argus, brings this family to a conclusion. It is very like the last in size and colour, but has a distinct white spot in the centre of each fore-wing. This we must not expect to find here, as I believe it has never been met with south of Yorkshire.

So now I turn to the last family, the Hesperidæ. These are easily recognised by the appearance of the head, which is larger in proportion to the insect than in the other families, and the antennæ in consequence appear set much wider apart. As I said some moths are often mistaken for butterflies, so also have I known people mistake some of this last family for moths. Their motion through the air rather conduces to this, for they do not fly with the steady flight of the rest, but dart rapidly about from flower to flower, and hover over the blossoms as they extract the nectar, something like the hawkmoths. From this motion no doubt they receive the English name of skipper. *Thymele Alveolus*, the grizzled skipper, is a little dark brown butterfly with a quantity of white spots on all its wings. I have taken it on the common near Bricket Wood, but not abundantly. Stainton says it frequents moist places near woods, but I have found it far more abundantly on dry hill-sides, where the grass only thinly covers the loose stones. May, June, and August it is on the wing, and as it is easy to capture and of wide range, it soon falls into the hands of the collector. *Thanaos*

Tages, the dingy skipper, is a week earlier in appearance than the last, after which it may often be taken on the same ground till the second week in June. It is well named, being a dingy brown, and to my mind is the least interesting of all our butterflies. *Steropes Paniscus*, the chequered skipper, is of a rich brown colour, chequered over with spots of yellow. This I have never seen on the wing, and believe it has been seldom taken out of the county of Huntingdon and those adjacent to it. It flies in June. *Pamphila Actæon*, the Lulworth skipper, is another insect we need not look for here, for we must visit the coast of Dorset or South Devon if we wish to make its acquaintance in a living state. It flies in August, and from all accounts, the quantity where it does occur, makes up in some degree for the paucity of localities it inhabits. *Pamphila Linea*, the small skipper, I have found common at midsummer, wherever I have been. The best place to find it is a marshy spot upon rather high ground, where it frisks about merrily amongst the reeds, yet I have seen it not unfrequently in woods far from any marsh or water. *Pamphila Sylvanus*, the large skipper, may be seen here in our lanes and woods in August, but as far as my observation goes, far more rarely than in any other county I have visited in the same month. With my next, *Pamphila Comma*, the silver-spotted skipper, I reach the end of my list. Though not nearly so widespread as the two last mentioned, yet wherever it does occur, there is generally a goodly company. On heaths in August you should look for it, and if you cannot find it nearer, you should go to Berkhamstead Common in quest of it, as it has been taken there. I have not mentioned the colour of the last four, as they are difficult briefly to describe, but they are all of a fulvous colour, marked with brown; *Actæon* being the smallest and darkest, and *Comma* being easily distinguishable by having several square white spots on the underside.

Thus have I spoken briefly, as I proposed, about each species—far too briefly to describe them at all accurately (fearing to weary you)—for in many cases a long description would be necessary to do this, and that twice over, as the sexes are often extremely different, not in markings merely, but oftentimes in their ground colour also. My great wish has been rather to give young collectors hope of success by indicating the nature of the localities where I myself have found the various species.

Whether this county has been as well worked as others I know not; but since my residence here I have never met a person carrying the net of gauze except on our own field days; save one or two of my own pupils who have lately evinced some love for this science. And it is very remarkable that this county is scarcely mentioned in such works as Stainton's 'Manual' and Newman's 'History of British Butterflies,' which make such frequent reference to all the contiguous counties. Yet, my own conviction is, that at least 50 out of the 66 species might be found here by any active entomologist. Unfortunately my time in June is too much occupied for taking any long walks, and in July and the

first half of August I have found it advisable to recruit my health some distance away, or I am sure I could have given you much more home information. I think a record should be kept by every society of this kind of all the species the neighbourhood affords in every branch of science, and as soon as possible a museum should be commenced in connection with it, to which all the members would doubtless be pleased to contribute as opportunity offered, and by means of which such instruction might be afforded as books alone cannot give.

I fear my paper has been already far too long, yet before closing I would make yet one remark. It may seem to some that it has too much encouraged the taking away of life; but if any have formed that opinion, I should wish at once to dispel it. I allow I have taken many, very many lives in pursuing this science; but I assure you, I believe I have prolonged the lives of ten times more than I have taken. As we spy about in search of prey ourselves, we find vast numbers of our prey in difficulties, caught perhaps in the snare some natural enemy has set for them, drowning perhaps in the water, or—what I always think worse—burning in the flame. These we rescue from a painful and lingering death, while the few we take we destroy in the most merciful way we can. Were we to put them to a lingering death or one attended with torture, they would beat themselves about in their death struggles and not be worth our preserving. Nor need you think when you see us out that we necessarily are destroying life. For the hundred we catch we do not kill one. My pleasure is to go to some old haunt and find the insect still there whose ancestor I saw perhaps the year before, perhaps not since a dozen years ago, but I leave them uninjured to enjoy their gay brief life. In several cases I have not added one specimen to my collection which I made more than twenty years ago.

Cruelty to the least of God's creatures I abhor, and would discountenance to the utmost all in the pursuit of this science who make it their first object to kill all they catch, or even kill with torture what they want; but to those who collect with a view to science, I can heartily wish God speed, knowing well they will discover in their researches more of the inscrutable power of the Creator, and by remarking the beauty, the regularity, and more especially the instinctive impulses which the Almighty has implanted in these lower animals, they will be induced to magnify their Creator more and more, and ascribe to Him that glory and honour and power of which He verily is worthy, for whose pleasure they are and were created.

9.—NOTES FOR OBSERVATIONS OF INJURIOUS INSECTS.

By ELEANOR A. ORMEROD, F.M.S.

Communicated by J. HOPKINSON, Hon. Sec.

[Read 9th May, 1878.]

A SERIES of observations in relation to insect ravages on the crops used as food is much to be desired, not only for scientific purposes, but also with a view to diminish the yearly losses to the country. Of these losses, telling heavily year by year both on the individual growers and the country at large, many would be remediable by more attention being directed to the subject; and many would probably be found to be so, if reliable information could be procured as to the circumstances affecting or coinciding with them. It is with this object that the assistance of their observations is now begged from Agriculturists and Entomologists, who practically and scientifically are both interested and can aid much in the matter, the information obtained to be condensed and forwarded to the observers in a printed Report.

The points chiefly to be noted are the *presence of surroundings*, such as plants, or shelter, suitable for the food or protection of the noxious insects; *agricultural conditions*, such as the drainage, the nature of the soil and manures, and that of the preceding crop on the ground, the amount of weed serving as insect food in the crop or growing near; and also the *state of the weather*.

It is observable that wet is injurious (generally speaking) to insects, and that drought, when not too prolonged, is favourable. How far these various conditions affect the amount of insect appearance is one of the objects sought to be ascertained by the observations proposed.

The observations on the insects under the head of "general remarks" should give the *date* of their appearance as larvæ; *numbers*, comparatively, to those in previous years; and also date and quantity of appearance, and date of disappearance, in the perfect state, with *amount of injury* to crop.

These various entries, though looking formidable in description, would take but a short time to enter on the columned sheet,* and would frequently be merely the observation of an ordinarily attentive naturalist in his daily walks, whilst the information they would give would be of solid value. Of course any additions to the list of objects, or additional information beyond the points noted, would add to the value of the return. It is particularly requested that observers will use the number and name given in the list in making their records, and will be good enough, in all the observations, to use the scientific name of the insect, the use of

* A copy of this sheet will be forwarded to any member on application to the Honorary Secretary.

local ones making many of the returns of former years nearly valueless for scientific purposes.

Any requisite information will be furnished on application to the Rev. T. A. Preston, The Green, Marlborough, Wilts; or to E. A. Fitch, Esq., Maldon, Essex; to either of whom it is requested the first specimen of each insect may be sent for verification, if not known with certainty.

The insects selected for observation are*—

1. *Haltica nemorum*. Turnip flea-beetle. Length about an eighth of an inch; blackish, with broad yellow stripe down each wing-case. Feeds on young turnip-leaves. Noticeable by its flea-like jumps, and generally known as "the fly."

2. *Anthomyia ceparum*. Onion fly. Larva whitish and footless; feeds in the bulb of the onion.

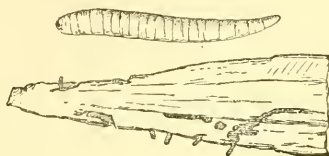


FIG. 1.—*Psila Rosæ*.

3. *Psila Rosæ*. Carrot fly. Commonly known in its effects as "rust." Larva ochreous in colour, small, and footless; pierces the roots of carrots and parsnips, causing rust-coloured stains.



FIG. 2.—*Mamestra Brassicæ*.

4. *Mamestra Brassicæ*. Cabbage moth. Caterpillar about an inch and a quarter in length; greenish or flesh-coloured, with a black tinge along the back and an oblique line on the back on

* Observations of any other insects would also be desirable, especially of the grubs of *Agrotis segetum* (the turnip moth) and allied species known as surface caterpillars, and of those whose names are given, noticeable either for their hurtfulness to the food crops, or special circumstances of weather frequently being coincident with their appearance.

every segment. Feeds on many green crops, especially piercing into the hearts of close-headed cabbage. Moth with upper wings greyish brown, variously streaked with black, slightly with white; under-wings brown, shading at the base to dirty white.

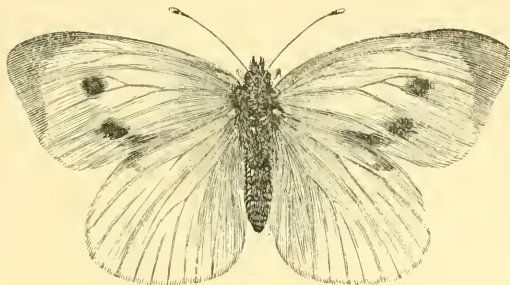


FIG. 3.—*Pieris Brassicae*.

5. *Pieris Brassicae*. Large white butterfly. Caterpillar green, or bluish, striped with yellow and dotted with black. Feeds on expanded cabbage-leaves. Butterfly white, with black tips to the wings; the fore-wings with two black spots above in the female, and beneath in both sexes.

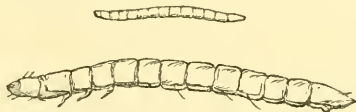
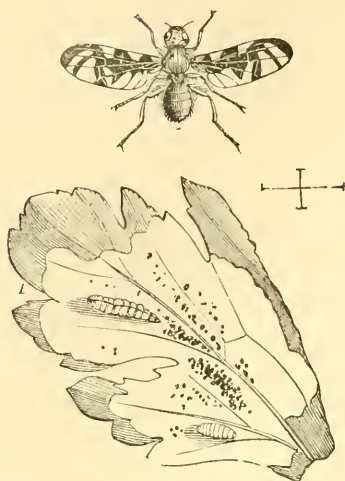


FIG. 4.—*Agriotes obscurus*.

Natural size and magnified.

6. *Agriotes (obscurus or other species)*. Wireworm. Larva long and narrow, like a piece of flattened wire; yellow and polished or leathery. Feeds for several years in the ground on young corn and most cultivated crops. Distinguishable from other grubs bearing the name by having three pairs of legs. Beetle about one-third of an inch in length, narrow, regains its position when laid on its back with a spring, accompanied by a sharp click.

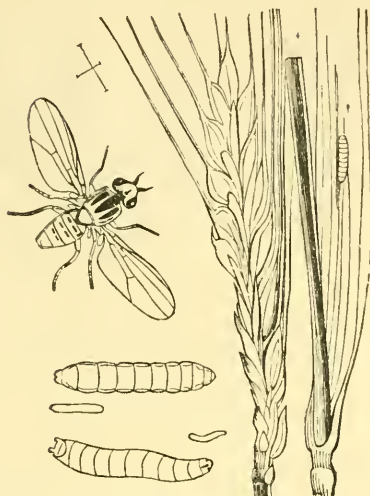
FIG. 5.—*Tephritis Onopordinis*.*

7. *Tephritis Onopordinis*. Celery and parsnip fly. Larva whitish and footless. Burrows between the two sides of the leaf so as to form large blisters.

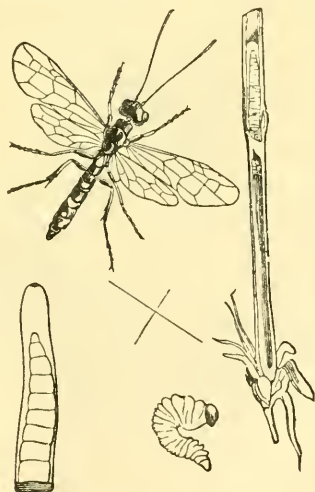
FIG. 6.—*Athalia spinarum*.

8. *Athalia spinarum*. Turnip sawfly. Fly four-winged, with orange and black body. Larva various shades of grey and black. Commonly known as the turnip nigger or "black jack." Feeds on turnip-leaves, and is at times excessively destructive.

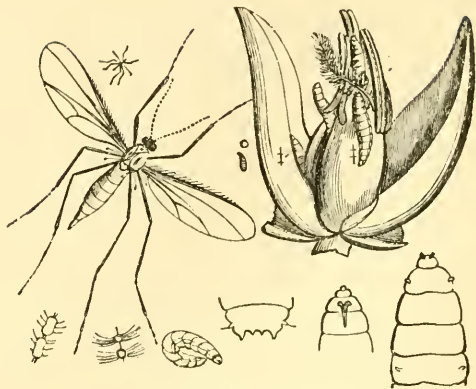
* The cross lines in this and the three following figures indicate the natural size.

FIG. 7.—*Chlorops tæniopus*.

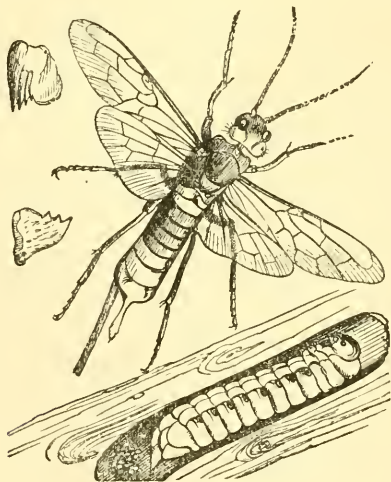
9. *Chlorops tæniopus*. Small grub causing a channel on the upper part of corn-stems, and abortion of the ear.

FIG. 8.—*Cephus pygmæus*.

10. *Cephus pygmæus*. Small grub inside corn-stalks, gnawing them nearly through at the ground-level in autumn.

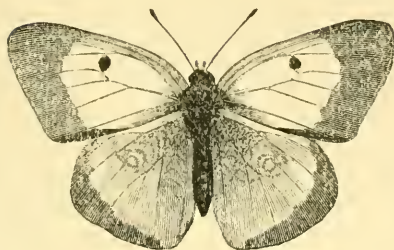
FIG. 9.—*Cecidomyia Tritici*.

11. *Cecidomyia Tritici*. Minute orange grub, occurring in some numbers in flowers and chaff of wheat, and commonly known as "red maggot." Very destructive, especially in white wheats.

FIG. 10.—*Sirex gigas*.

12. *Sirex gigas*. Four-winged fly, about an inch and a half long, colours black and yellow. Larva lives in fir timber.

13. *Asilus crabroniformis*. Black and orange hairy two-winged fly, about half an inch long. To be found in cattle-pastures in hot weather.

FIG. 11.—*Colias Edusa*.

14. *Colias Edusa*. Butterfly with orange wings, banded at the edges with black. Caterpillar feeds on Leguminous plants.

FIG. 12.—*Abraxas grossulariata*.

15. *Abraxas grossulariata*. Currant or magpie moth. Moth white, blotched with black and yellow. Caterpillar cream-colour, spotted with black, and with orange spots down the side.

16. *Neuroterus lenticularis*. Oak-spangle cynips. Causes the small reddish disks, sometimes found in great numbers on the back of oak-leaves.

Figures 5 to 10, and Fig. 12, are reproduced from drawings by Professor Westwood and Mr. Curtis, illustrating their papers on Entomology in the 'Gardeners' Chronicle,' by the kind permission of the Editor, Dr. Maxwell T. Masters, F.R.S.

10.—NOTES ON ECONOMIC ENTOMOLOGY.

By ELEANOR A. ORMEROD, F.M.S.

Communicated by J. HOPKINSON, Hon. Sec.

[Read 9th May, 1878.]

ANY additional arguments as to the necessity of horticultural or agricultural science are at the present day uncalled for; the importance of a thorough knowledge of the operations which are to provide primarily, or secondarily, a large portion of the national food, commending itself to all. But it is not so with the sister science of Economic Entomology. Although in great part with the same practical objects in view, the two subjects are popularly on very different footings, and although, during the last fifty years, the importance of Economic Entomology has attracted the attention of our own, as well as of some foreign Governments, and much has been done (especially by Museum illustration) to show both how our crops are injured, and how the injury is to be met, yet this is only a beginning, and to be followed by practical results it still requires more general attention.

With the necessary increase of food to meet the wants of the growing population, comes as surely an increase in the insect foes which feed on the desired crops, and the difficulty still remains in a great degree as stated by Audouin years ago. The practical workers who see and feel the effects of the injuries, have neither the time nor the knowledge requisite to work out the observations necessary to counteract them, and the scientific, to whom they refer for aid, though acquainted with the evil, are often unacquainted practically with the working effects of the prescribed remedies, which are necessarily not adapted for the exigencies of each separate case. Insect agency still needs bringing forward as a real existence—real as that of the crops yearly falling a prey to it, to the great loss of the country, as well as of individual growers; and to those who have not yet turned their attention to the subject, a few notes, though only conveying a most imperfect idea of the great variety of injurious insects, and of the extent of injury constantly or frequently caused by insect attack, may be acceptable. For this purpose I have availed myself, for the most part, of the reports given by Curtis, Kollar, and Kirby, also of memoirs in the ‘Journal of the Royal Agricultural Society,’ and of some of the excellent papers in the ‘Gardeners’ Chronicle.’

Beginning with the corn insects, the *Chlorops* (a minute two-winged fly) sometimes causes much mischief. Its presence in the crop may be known by the ear being usually unable to free itself from the sheathing leaves, and by a furrow in the stem from the base of the ear to the first joint below. A few years ago, in West Gloucestershire, it was only necessary to look round in a barley field to see at a glance the attacked heads, and on one occasion I found them in such numbers in a stack that the insects might be

shaken out by scores and hundreds. The *Chlorops* is given by Curtis as appearing in 1837 in myriads, in various parts of the country, and the barley in Lancashire is stated to have been destroyed to a great extent by *C. teniopus* in 1841.* In 1846 the barley crops are again noticed by Curtis as suffering severely from it in different places in four counties named to the extent of from half to two-thirds the crop. These insects also attack wheat and rye. *Cephus pygmaeus* (the corn saw-fly), which attacks the plant by travelling in the larval state throughout the interior of the stem previous to sawing it through, or nearly through, at the base, to facilitate its exit when developed, is numerous in this country; but the only returns of injuries to which I have access are the 'Annales d'Orléans,' and the report of M. Herpin, quoted by Curtis in 'Farm Insects,' which give them as a sixtieth part of the crop at Metz, but "much more considerable" in other localities named, and the appearance of a field attacked by saw-flies is described as seeming to have been traversed in every direction by sportsmen and animals.

The wheat midge, a small four-winged fly, effecting its injuries by abortion of the grain, may be found in enormous quantities, in the larval state, in chaff sweepings, or hovering, just developed, over old chaff heaps in June. The *Cecidomyia Tritici* is given in the excellent article on the subject in the 'Gardeners' Chronicle' for 1847, as being mentioned by Kirby as destroying at the end of the last century about a twentieth part of the crop in one spot; by Mr. Gorrie† as causing a loss in the Carse of Gowrie estimated at not less, in 1829, than £36,000; and by Dr. Asa Fitch,‡ as, in 1832, sweeping away the wheat crops completely; and the enormous numbers of this insect are given by Professor Henslow in tables§ as amounting to 834,952 pupæ and larvæ in seven bushels of barn-floor chaff and dust, collected from four different localities.

Passing on as briefly as possible with a few of the insects injurious to field crops generally, the surface caterpillars, which will probably be remembered as especially injurious a few years ago, when in some localities turnips were nearly destroyed by them, are a general evil. Taking only the references to them in Curtis' 'Farm Insects' (one here and there of many), it is noted that "in 1818, 1826, 1827, and 1836, but few vegetables escaped their ravages," and that in 1818 "scarcely a good turnip was left by them." These grubs may be found up to as many as from 12 to 30 at the root of one turnip or mangel wurzel, and in one case noted, 16,000 larvæ were picked from eight acres of swedes; and once in possession, the caterpillars from their large size make rapid work.

Wireworms (the long, yellow, hard-skinned larvæ of the *Elater* or click-beetle) feed during the five years through which (as far as can be ascertained) their larval state lasts, on grass and corn roots, turnips, potatoes, cabbage, and almost all our field crops. Twenty

* 'Journal of the Royal Agricultural Society,' vol. v, p. 491.

† 'Encyclopædia of Agriculture,' 3rd edition, p. 820.

‡ 'Transactions of the New York Agricultural Society,' vol. xiv, p. 691.

§ 'Journ. Royal Agricultural Soc.' vol. iii, p. 38.

or thirty may be found in one turnip bulb, and smaller growths are destroyed by the wireworm simply gnawing through the root, and then going on to a fresh plant.* From the larvæ remaining in the infested ground during the long period of feeding, all the successive crops put in are subjected to their ravages, and (as the case may be) successively injured or very possibly quite ruined. Kollar† gives the larvæ of *Elater lineatus* as “laying waste entire fields;” and where wireworms are numerous and unattended to, the mischief they cause only ceases with the destruction of everything in their power.

Amongst peas and beans, the pea-weevil clears off whole rows, and is noted as first taking the peas, later in the year attacking the beans, and then going on to the clover, and observations of the extensive and frequently-recurring ravages give it as “eating off the early peas”—“committing dreadful ravages”—“peas, beans, and other papilionaceous plants swarming with them,” and so on, the injuries in this case being the destruction of the leaves by the beetle. The *Bruchus granarius* lays eggs in the formed peas sometimes to the extent of every pea in the pod, and the black aphid attacks the tops of the beans. The *Silpha opaca*, or mangel wurzel beetle, brought under notice in England in 1844, destroyed the crops in Ireland, and also in France, successive sowings being sometimes swept off;‡ and, to take only a single instance more from the many insects injurious to stored corn, the *Calandra granaria*, or granary weevil, a small beetle which may literally be gathered up in handfuls from beneath the corn in neglected granaries, is calculated as giving a produce of 60·45 individuals from a single pair during the warm part of the year between April and September, and as each egg is deposited in a separate grain, the mischief is simply boundless. This affords one of the working examples of what may be done by attention thoroughly directed to the subject. The yearly loss to the great holders of grain would be something so serious if the beetle were not kept under, that its habits have been studied and the due remedy applied, whilst in small country holdings, where it is considered quite beneath attention, it may be found thriving, and I have seen half a wash-hand basinful of the beetles swept up at once.

Few who remember the thick clouds of *Aphides* which filled the air for about three days a few years ago, will doubt their immense power of increase given by Réaumur,§ as 5,904,900,000 in five generations from one *Aphis*, the damage from them being so great that in 1810 the pea-crop was injured throughout the country to the extent of making it difficult to procure the requisite supplies for the navy, and from the same cause it is stated that the difference in the amount of the duty on hops is “often as much as £200,000 per annum, more or less, as the fly prevails or the contrary.”||

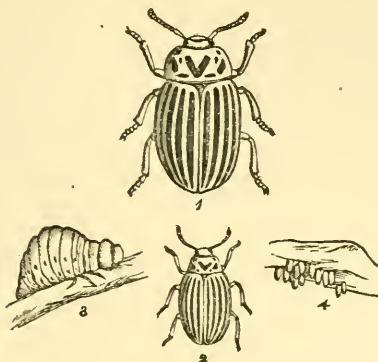
* ‘Transactions of the Entomological Society,’ vol. ii, p. 31.

† ‘Transactions of the Agricultural Society of Vienna,’ vol. v, p. 105.

‡ ‘Journal of the Royal Agricultural Society,’ vol. viii, p. 405.

§ ‘Mémoires pour servir à l’Histoire des Insectes,’ vol. vi, p. 566.

|| Kirby and Spence, ‘Introduction to Entomology,’ 1867, p. 100.



Colorado beetle—*Doryphora decemlineata*.

1. Beetle—magnified. 2, 3, and 4. Beetle, larva, and eggs, natural size.

Amongst foreign insects the Colorado beetle, *Doryphora decemlineata*, gives us an excellent instance of the effect of circumstances in spreading or checking an insect pest. We heard nothing of it till (following the opinion of the late Mr. A. Murray) the gradual introduction of the potato from the east of America formed as it were a bridge on which the beetle, transferring itself from its normal food plant, the *Solanum hirsutum*, crossed from its special home in Nebraska and Iowa to the shores of the Atlantic. The novelty as well as the importance of the attack raised the popular energies, and we know on the authority of the agricultural reports that where the proper remedy was applied, the insect succumbed; where this was not done, it thrived. The vine *Phylloxera* is another instance in point. The great importance of the subject has drawn thorough attention to it, and experiments, especially on the effect of applications at once beneficial to vegetation and prejudicial to insect life, are being instituted, which have a prospect of benefiting us both here and in their extended application.

Often, whether to field or garden crops, or to our forest trees, though there is much injury done that we do not at present know how to guard against, there is also much that the most ordinary observation and care would prevent, quite independently of any scientific knowledge, and the great point to be fairly driven into and kept constantly before the minds of the unscientific is, that the maggots, caterpillars, larvæ—whatever they may call them—will certainly go on feeding on the attacked plant till they are ready for the commencement of the change which, as certainly, unless preventive means occur, will send them out beetles, moths, or whatever they may be, to continue their species by scores or hundreds for every (apparently) insignificant grub. But we want something more. Take, for instance, the chrysomelid beetle

known as the "mustard-seed beetle" of the Fens. Last year it did damage estimated in one case at £1000 to a single proprietor, this year it has been widespread in its attack. Here and generally we want much more information as to the reasons of intermittent appearance. We want observations telling the life history of the insects, and the circumstances favourable to their production, or rather, those which accompany and precede their appearance when in the great numbers in which they are a serious evil. In some cases the eggs must have lain in the soil (here we want to know how long their vitality endures, and why they should have hatched in that particular season), in others the appearance of the springing crop is the signal for the appearance also of some special insect to eat it down—where did it lurk the while, and where will it lay the eggs which are to perpetuate the race? We know a very little about certain insects appearing with a certain succession of crops, which is one of the points which needs amplifying in every direction; and the characteristics of the particular season, the soil, manure, infected seed sown, infected fields in the neighbourhood, transportation by wind (sometimes a very important point), require attention, and thoroughly careful attention, extending over many years and many districts, before the requisite information suitable for general use can be obtained. But we benefit by the labours of those before us, and may well do our part where we can, and one most important point, in which all might aid, is in keeping attention alive to the living reality of insect agency in connection with our most important crops.

The grain of wheat, or the insect that feeds in it, are each, taken by themselves, of small importance, but in them taken collectively lies the cause but too often of the full or empty sack, and the corresponding returns to the owner and to the country at large.

11.—METEOROLOGICAL OBSERVATIONS TAKEN AT CASSIOBURY HOUSE FROM JANUARY TO APRIL, 1876.

By the RIGHT HONOURABLE THE EARL OF ESSEX.

[Read 9th May, 1878.]

ABSTRACT.*

JANUARY.—The mean pressure of the atmosphere was 30·26 ins. the highest reading, 30·60 ins. on the 15th; the lowest, 29·75 ins. on the 21st; range, 0·85 in.

The mean temperature of the air was 31°·8; the highest, 46° on the 1st and 31st; the lowest, 12° on the 12th; range, 34°: the mean high day temperature, 37°·2; the mean low night temperature, 26°·5; mean daily range, 10°·7. The highest temperature in the sun was 57° on the 24th.

The direction of the wind was N.E. on 8 days, E. on 6, S.E. on 2, S. on 8, S.W. on 5, and W. on 2. Easterly winds mostly prevailed to the 18th, then S.W. followed by N.E., and southerly for the last week.

Rain fell on 6 days, and snow on the 8th and 18th; the total amount of rain and melted snow being 0·88 in., and the greatest fall in one day 0·50 in. (as rain) on the 22nd.

The temperature sank to below freezing-point on 6 nights: 12 days were foggy.

FEBRUARY.—The mean pressure of the atmosphere was 29·84 ins.; the highest reading, 30·30 ins. on the 3rd; the lowest, 29·40 ins. on the 19th; range, 0·90 in.

The mean temperature of the air was 37°·3; the highest, 55° on the 22nd; the lowest, 16° on the 12th; range, 39°: the mean high day temperature, 43°·7; the mean low night temperature, 30°·9; mean daily range, 12°·8. The highest temperature in the sun was 67° on the 29th.

The direction of the wind was N.W. on 4 days, N.E. on 6, E. on 2, S.E. on 2, S. on 1, S.W. on 7, and W. on 7. North-easterly winds mostly prevailed for the first half of the month, and south-westerly for the last half.

Rain fell on 13 days, and snow on the 5th, 6th, and 14th, the total amount of rain and melted snow being 2·15 ins., and the greatest fall in one day 0·50 in. (as snow) on the 14th.

The temperature sank to below freezing-point on the 13th only. Fog prevailed on 5 days.

MARCH.—The mean pressure of the atmosphere was 29·60 ins.; the highest reading, 30·10 ins. on the 20th; the lowest, 28·80 ins. on the 12th; range, 1·30 in.

* This summary of the Earl's daily observations is in continuation of that of the previous eight months' observations published in the 1st Volume of the 'Transactions' (p. 132). The means, etc., are deduced as before.—ED.

The mean temperature of the air was $37^{\circ}5$; the highest, 57° on the 1st; the lowest, 19° on the 19th and 21st; range, 38° : the mean high day temperature, $45^{\circ}1$; the mean low night temperature, $29^{\circ}9$; mean daily range, $15^{\circ}2$. The highest temperature in the sun was 70° on the 23rd.

The direction of the wind was N.W. on 6 days, N. on 4, N.E. on 1, E. on 4, S.E. on 1, S. on 3, S.W. on 4, and W. on 8. Westerly winds (S.W. to N.W.) prevailed to the 18th, then northerly, and south-easterly for the last week.

Rain fell on 11 days, and snow on the 9th, 12th, 20th, and 22nd, the total amount of rain and melted snow being 3.09 ins., and the greatest fall in one day 0.75 in. (as snow) on the 12th.

The temperature sank to below freezing-point on the 19th only.

APRIL.—The mean pressure of the atmosphere was 29.90 ins.; the highest reading, 30.50 ins. on the 4th and 5th; the lowest, 29.00 ins. on the 19th; range, 1.50 in.

The mean temperature of the air was $43^{\circ}1$; the highest, 62° on the 8th; the lowest, 22° on the 13th; range, 40° : the mean high day temperature, $52^{\circ}1$; the mean low night temperature, $34^{\circ}0$; mean daily range, $18^{\circ}1$. The highest temperature in the sun was 83° on the 4th.

The direction of the wind was N.W. on 2 days, N. on 1, N.E. on 4, E. on 4, S.E. on 1, S. on 6, S.W. on 7, and W. on 5. Westerly winds prevailed for the first half of the month, then easterly, and south-westerly to the end of the month.

Rain fell on 8 days, and snow on the 13th, the total amount of rain and melted snow being 2.39 ins., and the greatest fall in one day 0.75 in. (as snow) on the 13th.

MAY 1875 to APRIL 1876.—The mean pressure of the atmosphere for the twelve months was 29.96 ins.; the highest reading, 30.60 ins. on the 15th of January; the lowest 28.80 ins. on the 12th of March; range, 1.80 in.

The mean temperature of the air was $46^{\circ}0$; the highest, 80° on the 4th of June; the lowest, 10° on the 4th of December; range, 70° : the mean high day temperature, $54^{\circ}3$; the mean low night temperature, $38^{\circ}9$; mean daily range, $15^{\circ}4$. The highest temperature in the sun was 105° on the 15th of May.

The direction of the wind was N.W. on 43 days, N. on 15, N.E. on 60, E. on 43, S.E. on 22, S. on 40, S.W. on 91, and W. on 52.

Rain (or snow) fell on 153 days, the total amount being 33.16 inches.

12.—METEOROLOGICAL OBSERVATIONS TAKEN AT HOLLY BANK, WATFORD, DURING THE HALF-YEAR ENDING 31ST AUGUST, 1877.

By JOHN HOPKINSON, F.L.S., F.M.S., etc., Hon. Sec.

[Read 9th May, 1878.]

THE observations of which some of the principal results are here given are in continuation of those commenced in March, 1876, and already published in our 'Transactions' (Vol. I, p. 217). They are only up to the end of August, owing to the observations at Holly Bank having been discontinued in September. In October I removed the instruments to my present residence—Wansford House—where the observations have since been carried on.

I have nothing to add to the previous account of the locality, the instruments, and the method of observation, but it may perhaps be advisable to repeat that all the readings given are corrected for the index errors of the instruments, and that the readings of the barometer are corrected for temperature and altitude. The mean temperature is as before deduced from the readings of the dry-bulb thermometer at 9 a.m. and 9 p.m., and the mean pressure of the atmosphere from the readings of the barometer at the same hours.

The monthly means of these observations and of other results deduced from them are given in the accompanying table (p. 92). From it the following table, giving some of the most important results grouped into seasons, is compiled.

WATFORD.

Seasons 1877.	Mean Pressure.	Mean Tempera- ture.	Mean Daily Range.	Tension of Vapour.	Relative Humidity	Rainfall.
	ins.	°	°	ins.	%	ins.
Spring	29·813	44·0	14·2	·228	79	7·88
Summer	29·950	59·2	18·1	·354	73	7·81

For comparison the observations at the Greenwich Observatory are computed as before from Mr. Glaisher's "Remarks on the Weather" in the Registrar-General's Quarterly Reports, the values given for mean pressure being reduced to sea-level.

GREENWICH.

Seasons 1877.	Mean Pressure.	Mean Tempera- ture.	Mean Daily Range.	Tension of Vapour.	Relative Humidity	Rainfall.
	ins.	°	°	ins.	%	ins.
Spring	29·797	45·0	15·5	·232	75	6·8
Summer	29·936	61·3	21·4	·384	71	6·0

RESULTS OF METEOROLOGICAL OBSERVATIONS TAKEN AT HOLLY BANK, WATFORD.

MONTHS.	Mean Pressure.	AIR TEMPERATURE.								Tension of Vapour.	Relative Humidity.
		Mean.	Means of		Mean Daily Range.	Absolute Min. and Max.					
			Min.	Max.		Min.	Day.	Max.	Day.		
March, 1877	ins.	°	°	°	°	°	°	ins.	%		
April	29.757	39.1	33.2	46.4	13.2	20.6	54.3	.203	86		
May	29.789	44.7	37.0	51.1	14.1	32.3	60.1	.230	77		
June	29.892	48.3	40.0	55.4	15.4	23.6	63.1	.250	73		
July	30.029	60.1	49.3	73.6	24.3	42.1	79.4	.370	71		
August	29.930	58.1	49.5	64.2	14.7	43.9	80.9	.388	73		
August	29.891	59.5	50.9	66.3	15.4	37.0	74.0	.405	75		

MONTHS.	Amount of Cloud. 0-10.	Force of Wind 0-12.	RAINFALL.			No. of days of		WIND—No. of Observations of.									
			Total.	Max.	Day.	Rain.	Snow.	N.	N.E.	E.	S.E.	S.	S.W.	W.	N.W.	Calm.	
March, 1877	6.3	2.3	2.67	.33	29th	22	6		5	2	3	2	3	7	4	3	2
April	8.4	2.7	2.79	.45	9th	17	0		3	5	6	5	4	1	2	4	0
May	7.4	2.4	2.42	.52	16th	16	0		4	8	3	2	2	5	3	4	0
June	5.0	2.2	1.26	.33	30th	8	0		4	3	3	2	3	5	5	2	3
July	6.1	1.2	2.99	.66	14th	14	0		1	0	0	0	3	10	12	4	1
August.....	5.9	2.1	3.66	1.11	21st	20	0		4	0	0	1	2	15	3	5	1

In the six months to which these observations refer (March to August, 1877) there are no very remarkable features to record. The month of March was excessively cold, having a mean temperature below that of either of the three winter months—December, 1876, and January and February, 1877. June was exceptional in being the hottest month of the summer. It was also the driest, and had by far the longest period without rain. The rainfall in July and August, on the other hand, was unusually heavy for those months, and the temperature was below the average.

The following notes on the months are, as before, merely supplementary to the table, in conjunction with which they should be read. All the values given are corrected.

MARCH.—The lowest night temperature recorded since these observations were commenced occurred on the night of the 28th February—1st March. The weather had been getting colder towards the end of February, and on this night the temperature reached its minimum. A sudden change now occurred, as shown by the following observations, the mean of which gives a rise of 13° from the 1st to the 2nd.

		9 a.m.		9 p.m.		min.		max.
1st.	.....	$29^{\circ}\cdot 2$	.....	$36^{\circ}\cdot 3$	.....	$20^{\circ}\cdot 6$	.....	$41^{\circ}\cdot 5$
2nd.	.....	$43^{\circ}\cdot 2$	.....	$47^{\circ}\cdot 8$	.....	$33^{\circ}\cdot 5$	.....	$52^{\circ}\cdot 0$

On the night of the 2nd–3rd the minimum only sank to $44^{\circ}\cdot 4$. This warm weather lasted only three days, and throughout the month the temperature was almost equally variable, there being an alternation of warm and cold periods. The minimum of the 1st was nearly reached on several other days, $24^{\circ}\cdot 7$ being recorded on the 11th, $23^{\circ}\cdot 3$ on the 19th and 22nd, and $22^{\circ}\cdot 2$ on the 23rd; and on seven other days, or twelve days in all, the minimum was below 32° . The maximum of the 29th was also nearly approached on the 14th, when $53^{\circ}\cdot 5$ was recorded. With this exception the last four days were the warmest in the month, the maximum being $53^{\circ}\cdot 8$ on the 28th, $54^{\circ}\cdot 3$ on the 29th, $54^{\circ}\cdot 2$ on the 30th, and $52^{\circ}\cdot 3$ on the 31st. The mean of the last seven days was $6^{\circ}\cdot 7$ above that of the month. The mean temperature of the month was $2^{\circ}\cdot 4$ lower than that of February, and $1^{\circ}\cdot 2$ lower than that of January. Atmospheric pressure, which was highest, $30\cdot 408$ ins., at 9 a.m. on the 1st, decreased in a remarkably gradual manner to the 25th, when the mercury stood, at 9 a.m., at $28\cdot 955$ ins., after which it rose each day without interruption to the end of the month. There was no atmospheric disturbance—violent wind or heavy rain—at the time of lowest pressure. The direction of the wind was as variable as the temperature. It was mostly northerly for the first half of the month, and south-westerly towards the end. Snow fell on the 7th, 8th, 11th, 17th, 20th, and 21st, and hail on the 7th and 17th. The mornings of the 2nd and 4th were foggy. A lunar halo was observed on the evening of the 28th.

APRIL.—Atmospheric pressure, which had been increasing during the last week in March, began to decrease on the 1st, and the

mercury was at its lowest point, 29·101 ins. at 9 p.m. on the 4th, after which it was unsteady for the greater part of the month, rising to 30·257 ins., its highest point, at 9 a.m. on the 20th, and to the same again at 9 p.m. on the 30th. At about 4.30 p.m. on the 4th, the day of lowest pressure, there was a remarkable and very destructive storm in the neighbourhood of Ware, which has been fully described by Lieut. Croft, F.L.S., in our 'Transactions.'* At Watford it was scarcely felt, there being only a slight thunder-storm in the evening, with heavy rain commencing at about 11 p.m., accompanied by a strong S.W. wind. At Enfield, between 4 and 4.20 p.m., hailstones three-quarters of an inch in diameter are recorded to have fallen, and considerable damage was done.† The temperature of the air was much more uniform than in March; but the last half of the month was much colder than the first half, the mean temperature from the 1st to the 15th being 46°·6, and from the 16th to the 30th, 42°·6. The maximum of the 4th (60°·1) was only reached within 5° on one other day, the 22nd, when 58°·8 was recorded. The wind was mostly easterly, inclining to S.E. the first half of the month—the warm period—and to the N.E. the last half—the cold period. Most of the rain fell during the warm period, and there was none after the 23rd, when the first really fine weather of the year commenced, there not having been more than three days in succession without rain up to this time—not only in the year, but from the beginning of November. Although more rain fell than in the previous month, the air was considerably drier, the degree of humidity being 12 per cent. less, as shown in the table. Hail fell on the 4th, 5th, and 17th. The morning of the 9th was foggy.

MAY.—The first few days were remarkably cold, and during the six days from the 3rd to the 8th the minimum was below 32° on five. The following readings of the minimum thermometer give a mean low night temperature, for this period, of 29°·4, which is 14°·2 lower than the mean minimum readings of the next seven days, and 10°·6 lower than the mean minimum of the month.

3rd	30°·7	5th	23°·6	7th	32°·0
4th	28°·1	6th	30°·0	8th	30°·7

Atmospheric pressure was high at the beginning of the month, being 30·418 ins. at 9 p.m. on the 1st, after which it gradually decreased to 29·401 ins. at 9 p.m. on the 10th, increased in an almost equally gradual manner to 30·256 ins. at 9 p.m. on the 22nd, and again decreased to 29·249 ins. at 9 a.m. on the 28th. The prevailing direction of the wind was north-easterly for the first half of the month, S. to S.W. on the 16th and 17th, then northerly to the 25th, S.E. on the 26th, and south-westerly for the last five days. No rain fell until the 9th, there being thus, from the 23rd of the previous month, fifteen days without rain; but

* Vol. I, p. 230.

† Symons' 'Meteorological Magazine,' vol. xii, p. 43.

after the 9th there were not more than two days in succession without rain.

JUNE.—After the 28th of May the pressure of the atmosphere increased slightly, decreasing again to 29·395 ins. at 9 a.m. on the 1st of June, the lowest pressure during the month. The mercury then rose rapidly, standing at 29·764 ins. at 9 p.m. on the same day, still rising for the next few days, and remaining high for the rest of the month, with the exception of a slight depression on the 22nd (29·577 ins. at 9 p.m.). The highest reading was 30·265 ins. at 9 a.m. on the 28th. The unusually high temperature of this month has already been alluded to. Although the maximum reached is entered to the 29th, there was no appreciable difference on the 18th, and only half a degree on the 19th. The following are the readings of the maximum and minimum thermometers for three days at each of these warm periods.

	min.		max.		min.		max.
17th	52°·2	.....	76°·1	28th	44°·0	.....	74°·6
18th	50°·2	.....	79°·3	29th	52°·5	.....	79°·4
19th	49°·9	.....	78°·9	30th	50°·7	.....	71°·2

The maximum was above 70° on seventeen days and above 74° on ten. The direction of the wind was very variable, not being the same for any three days together throughout the month; and, as shown in the table, it was pretty evenly divided over the different points of the compass. Rain fell on four days at the beginning of the month and on four days towards the end. There was none for the fourteen days from the 7th to the 20th inclusive—an unusually long dry period. There was a thunderstorm on the night of the 4th.

JULY.—The temperature of the air was unusually low for the greater part of the month, the only warm periods (with a maximum exceeding 70°) being from the 10th to the 13th, mean of the maximum 71°·9, and from the 29th to the 31st, mean of the maximum 79°·4, the *mean* temperature of these periods being respectively 63°·8 and 65°·6. The maximum only exceeded 80° on the last day of the month. It exceeded 70° on eight days. Atmospheric pressure continued high (from June) for the first twelve days, the mercury, after a slight fall, reaching its highest point, 30·322 ins., at 9 a.m. on the 9th, after which it fell to 29·218 ins. at 9 a.m. on the 15th, rising again towards the end of the month and nearly again reaching its highest point on the 30th. The wind maintained a westerly or south-westerly direction almost throughout the month, inclining a little towards N.W. for the first few days, and towards S. between the 14th and 23rd. The rainfall was pretty evenly distributed over the month. The maximum of the 14th was nearly equalled on the 16th, when 0·64 in. of rain fell. There were thunderstorms on the 3rd, 5th, 6th, and 7th, and hail fell on the evening of the 3rd.

AUGUST.—For the first four days the mean temperature was 58°·0, being 1°·5 below the mean of the month; and for the next

four days it was $64^{\circ}5$, or $6^{\circ}0$ above it. No considerable change occurred again until the 23rd, that and the following day being very cold. The temperature then rose again to above the monthly mean. There were two periods with the daily maximum above 70° , the 5th and 6th, mean of the maximum $73^{\circ}3$; and the 14th to 21st, mean of the maximum $71^{\circ}5$. The mean temperature for these periods was $65^{\circ}2$, and $64^{\circ}4$, respectively. Atmospheric pressure was less variable than in any previous month in the year, ranging from 29.496 ins. at 9 a.m. on the 8th, to 30.202 ins. at 9 a.m. on the 24th. For the first four days the wind was north-westerly, and south-westerly winds (S. to W.) prevailed from the 5th to the end of the month, with an interval of four days (11th to 14th) with a northerly, and of one (25th) with a S.E., wind. There was no interval of more than a day without rain, except the 4th and 5th, and the 10th to 13th. The heaviest falls were towards the end of the month. On the 25th 0.85 in. of rain fell, the only near approach to the maximum of the 25th. There was a very severe thunderstorm between 5.30 and 6 a.m. on the 19th, and a heavy gale on that and the following night. Thunderstorms also occurred on the morning of the 25th and on the night of the 26th.

13.—REPORT ON THE RAINFALL IN HERTFORDSHIRE IN 1877.

By JOHN HOPKINSON, F.L.S., F.M.S., Hon. Sec.

[Read 9th May, 1878.]

THE Report on the Rainfall in 1876, recently published in our 'Transactions' (Vol. I, p. 225), comprised the records of 23 rain gauges from returns received from 22 observers. For last year returns have been received from 26 observers. From two of the 1876 observers—one at Watford and the other at Berkhamstead—returns for 1877 have not been received, but as we have five other observers at Watford, and one at Berkhamstead, the omission of these from the present report is not of much consequence. The six returns now received for the first time are all from localities not before represented, and therefore add materially to our means for determining the distribution of rain over the county.

Particulars of the gauges, with the names of the observers, are given in the following table:—

STATION.	OBSERVER.	Diameter of Gauge.	Height of Gauge above	
			Ground.	Sea-level.
		ins.	ft. ins	ft.
Watford—Bushey Station	Robert Savill	5	0 8	220
„ Watford House	A. T. Brett, M.D.	8	1 3	240
„ Holly Bank.....	John Hopkinson	5	1 0	270
„ Oaklands.....	Edward Harrison	5	5 6	273
„ Cassiobury	The Earl of Essex	5	1 3	258
Rickmansworth—Moor Park	Lord Ebury	5	2 0	340
St. Albans—Gorhambury	The Earl of Verulam	6	2 9	
Harpenden—Rothamsted	Lawes and Gilbert	5	0 9	420
„ „ (2nd gauge)	„ „ „	*	0 9	420
Kensworth [Dunstable]	Miss Grace Jones	5	1 0	902
Hemel Hempsted—Nash Mills	J. Dickinson & Co.	12	3 9	237
Berkhamstead—High St.	William Squire.....	8	1 6	370
Great Gaddesden	Rev. W. T. Drake	8	1 2	
Tring—Cowroast	Hubert Thomas, C.E.	10	4 2	345
East Barnet—Southgate	H. F. Church	6	0 6	240
Hoddesdon—Feildes Weir	Beardmore and Barnes	20	3 0	82
Hertford—Bayfordbury	W. Clinton Baker.....	8	0 4	250
Ware.....	New River Company.....	12	3 0	114
Welwyn	Rev. C. L. Wingfield	5	0 6	
Knebworth	Rev. F. G. Jenyns	5	1 0	407
Stevenage	Rev. J. O. Seager	8	2 0	319
Buntingford—Aspenden	Rev. A. P. Sanderson	5	1 1	329
Therfield	Rev. J. G. Hale	5	4 3	400?
Much Hadham	Rev. H. S. Mott	5	1 0	222
Hitchin	William Lucas	9	1 6	238
Odsey.....	H. George Fordham.....	5	1 0	263
Royston.....	Hale Wortham.....	8	0 6	269

* Receiving area $\frac{1}{1000}$ of an acre.

The localities are arranged in the same order as before, *i.e.* grouped according to Mr. Pryor's proposed botanical divisions* and the distance from Watford. The same four divisions and twelve minor districts as in the previous year are represented.

The accompanying table (p. 99) gives the monthly and annual rainfall† at each station. It will be seen to have been more evenly distributed over the year than in 1876. January and November were the wettest months, and July and August follow. June and September were the driest.

The next table gives the mean rainfall for each of the larger divisions or main river-basins, and also for each of the smaller districts or lesser river-basins and their subdivisions.

Colne.....32·80	{ Lower Colne..... 31·79		{ Lower Lea 29·86
	{ Ver 34·39		{ Upper Lea 29·21
	{ Bulborne 32·23		{ Mimram 29·78
Thame 34·63	Thame 34·63	Lea.....29·72	{ Beane 30·35
Ouse..... 28·36	Ivel 29·68		{ Rib 29·84
	Cam 27·04		{ Ash 29·29

In 1876 the distribution of rain in the main river-basins was—in the Colne 32·28 inches, Thame 34·09, Ouse 28·52, and Lea 29·08, showing that the rainfall was in about the same relative proportion in each district in the two years, the Thame receiving the greatest amount of rain, then the Colne, then the Lea, and the Ouse having the least.

Of the 26 observers 22 give the number of days in each month on which ·01 inch of rain or more fell. The mean of these for the different months is as follows:—

Jan. 23·8	April..... 14·7	July 15·0	Oct. 13·5
Feb. 17·0	May 16·4	August..... 18·4	Nov. 20·6
March 18·4	June 7·1	Sept. 11·0	Dec. 17·4

giving a mean for the year of 193·3 days,—about $10\frac{1}{2}$ days more than in 1876. The least number of rainy days were at Therfield (150), St. Albans (165), and Hoddesdon (173); the greatest, at Oaklands, Watford (214), Nash Mills (214), and Harpenden (220). The numbers nearest the mean were at Rickmansworth (190), Much Hadham (191), and Odsey (193).

These 22 returns also give the greatest amount of rain which fell in any one day in each month; and from these particulars the following table is compiled. It shows at what station there was the greatest fall in 24 hours in each month, with the day of the month and the amount of the fall.

	ins.		ins.
Jan. 3.—Great Gaddesden	0·86	July 31.—Therfield	1·04
Feb. 12.—East Barnet	0·50	Aug. 25.—East Barnet	1·16
Mar. 29.—Rickmansworth	0·48	Sept. 3.—Kensworth	1·45
April 9.—Welwyn	0·76	Oct. 29.—St. Albans	1·15
May 16.—Bayfordbury	0·75	Nov. 11.—Berkhampstead	1·42
June 30.—Buntingford	0·64	Dec. 28.—Therfield	0·81

* 'Transactions,' Vol. I, p. 67; and map, Plate I.

† The amounts entered as rain include melted snow.

HERTFORDSHIRE RAINFALL IN 1877.

DISTRICT.	STATION.	JAN.	FEB.	MAR.	APR.	MAY.	JUNE.	JULY.	AUG.	SEPT.	OCT.	NOV.	DEC.	TOTAL.	
{ Lower Colne	Watford—Bushey Station	ins. 4'87	ins. 1'77	ins. 2'88	ins. 2'82	ins. 2'68	ins. 1'02	ins. 3'90	ins. 3'54	ins. 1'02	ins. 1'30	ins. 4'57	ins. 2'35	ins. 32'72	
	" Watford House	4'90	1'85	2'76	2'54	2'27	1'13	2'93	3'50	1'05	1'28	4'17	1'73	30'11	
	" Holly Bank.....	4'93	1'93	2'67	2'79	2'42	1'26	2'99	3'66	'88	1'99	4'53	2'26	32'31	
	" Oaklands.....	4'90	1'86	2'72	2'85	2'46	1'24	3'20	3'48	'87	2'01	4'59	2'22	32'40	
	" Cassiobury	4'56	1'59	2'55	2'43	2'04	1'11	3'81	3'39	'80	1'96	4'40	2'24	29'88	
{ Ver	Rickmansworth—Moor Park	5'52	2'08	2'84	2'48	2'50	'62	3'81	3'50	1'05	2'31	4'66	2'40	33'32	
	St. Albans—Gorhambury	4'85	1'93	2'86	2'92	3'23	1'64	3'65	3'65	1'20	1'53	5'80	2'18	36'71	
	Harpenden—Rothamsted	4'82	1'98	2'52	2'68	2'79	1'39	3'23	2'56	1'53	1'90	5'15	2'28	32'83	
	" " (2nd gauge)	4'99	2'10	2'55	2'76	2'82	1'43	3'28	2'60	1'53	1'95	5'16	2'28	33'45	
	Kensworth	4'63	2'20	1'71	2'79	2'96	1'01	3'89	3'36	2'60	1'53	5'16	2'37	34'58	
{ Bullborne and Gade.	Hemel Hempstead—Nash Mills	4'85	1'95	2'76	2'55	2'60	1'48	3'33	3'03	2'67	1'89	5'10	2'37	34'58	
	Berkhamstead—High St.	5'21	2'03	2'39	2'96	2'88	1'20	3'35	3'03	1'02	1'96	5'37	2'47	33'87	
	Great Gaddesden	4'70	1'77	2'12	2'15	2'75	1'13	3'41	2'80	1'03	1'71	4'75	2'02	30'34	
	Tring—Cowroast	5'58	2'19	2'17	2'47	3'38	'90	3'40	2'98	1'32	1'93	5'61	2'70	34'63	
	East Barnet—Southgate	5'08	2'11	2'39	3'51	2'27	'60	4'04	4'56	'96	2'04	3'49	1'96	33'01	
{ Lower Lea	Hoddesdon—Feildes Weir	4'50	1'78	2'35	2'53	2'38	'84	2'80	3'19	1'16	1'49	3'95	2'23	29'39	
	Hertford—Bayfordbury	4'69	1'78	2'35	2'53	2'38	'84	2'80	3'19	1'16	1'49	3'95	2'23	29'39	
	Ware	4'18	2'22	2'06	1'90	2'28	'68	2'92	2'97	1'55	1'29	5'00	1'98	29'03	
	Welwyn	4'37	1'78	2'36	3'22	2'21	1'03	2'92	3'06	1'36	1'47	4'27	1'73	29'78	
	Knebworth	4'12	2'26	2'16	3'26	2'02	1'09	3'56	3'30	1'88	1'22	3'63	2'35	30'85	
{ Upper Lea	Stevenage	4'04	1'90	2'05	3'29	2'44	1'14	2'81	3'22	1'91	1'17	3'93	1'96	29'86	
	Buntingford—Aspenden	3'52	2'31	2'39	2'26	2'20	1'09	3'89	3'66	1'52	1'09	3'46	2'03	29'42	
	Therfield	3'55	2'18	1'92	2'86	2'07	'75	4'88	3'83	1'66	1'11	3'41	2'04	30'26	
	Much Hadham.....	4'47	2'28	2'49	1'80	2'20	1'00	3'38	3'61	1'52	1'13	3'48	1'93	29'29	
	Hitchin	3'74	1'76	1'99	3'31	2'52	'98	3'23	3'02	1'79	1'38	3'94	2'02	29'68	
{ Ash Ivel	Odsey	2'83	1'84	1'90	2'91	2'92	1'02	3'18	3'03	1'42	'91	3'16	1'74	26'86	
	Royston.....	3'17	1'94	1'81	2'31	2'54	1'16	3'69	3'34	1'49	'87	3'11	1'79	27'22	
	{ Cam	Mean.....	4'50	1'98	2'36	2'68	2'52	1'07	3'35	3'28	1'36	1'61	4'35	2'09	31'15

The days on which the greatest amount of rain in each month at any station is recorded to have fallen are now given, with the number of stations at which this maximum monthly fall occurred. The days when the amount was the maximum fall in the month, as shown above, are indicated by italics.

January—3rd, *the wettest day at 20 stations*; 10th at 2.

February—12th at 3; 13th at 5; 15th at 1; 19th at 10; 22nd at 1; 25th at 2.

March—3rd at 4; 4th at 1; 7th at 4; 20th at 2*; 23rd at 2; 29th at 9.

April—4th at 3; 9th at 18; 23rd at 1.

May—11th at 2; 12th at 1; 16th at 15; 18th at 2; 20th at 1; 31st at 1.

June—1st at 7; 11th at 1; 21st at 3; 22nd at 1; 30th at 10.

July—14th at 17; 23rd at 1; 25th at 2; 31st at 2.

August—8th at 2; 21st at 6; 25th at 8; 26th at 5; 27th at 1.

September—2nd at 4; 3rd at 14; 11th at 2; 14th at 2.

October—21st at 1; 22nd at 1; 23rd at 2; 25th at 1; 29th at 17.

November—5th at 1; 9th at 1; 11th at 20.

December—5th at 1; 28th at 20†; 30th at 1.

The days on which a heavy fall of rain was most general over the county are thus clearly shown, and by comparing the above with the previous table some idea of the amount of the fall may be formed.

January and November have been stated to have been the wettest months in the year. On the 11th of November a fall exceeding one inch occurred at the greatest number of stations during the year. In January, on the other hand, there was no daily fall equal to one inch anywhere, the excess in this month being due to continuous wet weather, rather than to any great downpour. Falls exceeding one inch occurred every month from July to November; but on no occasion was a fall equal to one inch recorded during the first half of the year. The following are the falls of an inch or more recorded on the days of maximum monthly fall:—

July 25—Buntingford, 1·02.

July 31—Therfield, 1·04.

August 21—Holly Bank, Watford, 1·11; Oaklands, Watford, 1·00.

August 25—East Barnet, 1·16.

September 3—Kensworth, 1·45; Stevenage, 1·04; Hitchin, 1·04.

October 29—St. Albans, 1·15.

November 5—Ware, 1·40.

November 11—St. Albans, 1·25; Harpenden, 1·38; Nash Mills, 1·06; Berkhamstead, 1·42; Great Gaddesden, 1·32; Tring, 1·40; Welwyn, 1·00; Stevenage, 1·18; Hitchin, 1·31.

The rainfall in 1877, as in the two previous years, was considerably above the average, there having thus been three wet years in succession. From the records of former years I have received, about 26 inches appears to be the average for the county, but records extending as far as ten years back have as yet only been received from three observers. A report on the rainfall of past years cannot therefore yet be prepared.

* Snow.

† Snow and rain.

14.—REPORT ON PHENOLOGICAL OBSERVATIONS IN HERTFORDSHIRE IN 1877.

By JOHN HOPKINSON, F.L.S., F.M.S., Hon. Sec.

[Read 9th May, 1878.]

THE present Report on Phenological Phenomena differs chiefly from that for 1876 ('Transactions,' Vol. II, p. 37) in comprising returns from three localities—Watford, Ware, and Odsey—whereas in 1876 observations were made at Watford and Ware only. Our additional observer is Mr. H. George Fordham, F.G.S., of Odsey Grange. At Ware Mr. Carter has discontinued observing, so that we are indebted to Lieut. Croft, F.L.S., for all the observations made there. The observations for Watford are contributed as before, where not otherwise stated, by myself.

Following the same plan as in the previous report, I give first a record of the dates on which the flowers of plants in the Meteorological Society's list were observed to be open. When a date earlier than the actual date of observation is given as the probable day on which any flower opened, a (?) is added as before. In such cases the limit of alteration is three days.

Of the 44 plants here enumerated (about the same number as in the previous year) it will be seen that 23 were observed by myself at Watford, 26 by Lieut. Croft at Ware, and 19 by Mr. Fordham at Odsey. The dates appear on the average to be about the same at Watford as at Ware, and rather later at Odsey, but so few plants have been observed in all the three localities, that a satisfactory comparison cannot be made. The result arrived at is however what would naturally be expected, Odsey being considerably to the north of both Watford and Ware.

Comparing together the years 1876 and 1877, we find that out of the 38 species of plants observed in both years, 10 came into flower earlier and 10 later in 1877 than in 1876, while 18 flowered at about the same time in both years. Taking each year as a whole there was therefore no difference in the state of vegetation as determined by the flowering of plants. When, however, different months of these two years are compared, it will be found that the earlier dates for 1877 are in the months of February, March, and April, and the later dates chiefly in May and June; showing that in the early spring vegetation was more forward last year than in 1876, while later in the spring and in the summer it was more backward. A reference to a meteorological register will show this to be due to the mild winter of 1876-77, and the cold weather which followed in the spring. At Watford, for instance, the mean temperature of the three winter months (December, January, and February) was $41^{\circ}\cdot8$,* while the mean temperature of March was only $39^{\circ}\cdot1$.† This mild winter weather brought plants into flower

* 'Transactions,' Vol. I, p. 219.

† *Ib.* Vol. II, p. 92.

almost too soon early in the year, and afterwards the cold weather of March retarded their flowering in some cases by two or three weeks.

No.	Species.	Watford.	Ware.	Odsey.
1.	<i>Anemone nemorosa</i> (wood anemone)		Mar. 24	
2.	<i>Ranunculus Ficaria</i> (pilewort)		Feb. 7	
3.	<i>Ranunculus acris</i> (upright crowfoot)	May 4		
4.	<i>Caltha palustris</i> (marsh marigold).....		Mar. 30	
5.	<i>Papaver Rhæas</i> (red poppy)	June 9	June 14	May 29
7.	<i>Cardamine pratensis</i> (cuckoo flower)		April 13	
9.	<i>Viola odorata</i> (sweet violet).....			Feb. 6
10.	<i>Polygala vulgaris</i> (milkwort)		May 2	June 3
11.	<i>Lychnis Flos-cuculi</i> (ragged Robin)	June 11		
12.	<i>Stellaria Holostea</i> (greater stitchwort)	April 8	Mar. 29	
13.	<i>Malva sylvestris</i> (common mallow).....	June 17	June 16	June 24
16.	<i>Geranium Robertianum</i> (herb Robert)	May 20	April 19	
17.	<i>Trifolium repens</i> (Dutch clover).....	June 2	June 1	
18.	<i>Lotus corniculatus</i> (bird's-foot trefoil)	June 11	June 8	
20.	<i>Vicia sepium</i> (bush-vetch)		May 27	
21.	<i>Lathyrus pratensis</i> (meadow vetchling).....	June 13	June 18	
22.	<i>Prunus spinosa</i> (blackthorn)		Feb. 24	Mar. 5
24.	<i>Potentilla anserina</i> (silver-weed).....	June 5		June 4
26.	<i>Rosa canina</i> (dog rose).....	June 13	June 14	June 14
28.	<i>Epilobium montanum</i> (broad willow herb)	June 17		
30.	<i>Anthriscus sylvestris</i> (wild chervil)		April 15	April 27
31.	<i>Hedera Helix</i> (ivy)			Nov. 13
32.	<i>Galium Aparine</i> (cleavers)	May 24	May 27	
33.	<i>Galium verum</i> (yellow bedstraw)			July 2
37.	<i>Tussilago Farfara</i> (coltsfoot)		Feb. 7	Mar. 2
38.	<i>Achillea Millefolium</i> (milfoil).....	July 5?		
39.	<i>Chrysanthemum Leucanthemum</i> (ox-eye)	May 31	June 2	May 31
41.	<i>Senecio Jacobæa</i> (ragwort)			July 11
46.	<i>Hieracium Pilosella</i> (mouse-ear).....	June 3		
47.	<i>Campanula rotundifolia</i> (hair-bell).....	July 10		July 13
51.	<i>Pedicularis sylvatica</i> (red rattle).....	May 5		
52.	<i>Veronica Chamædrys</i> (germander speedwell)	April 22		
57.	<i>Nepeta Glechoma</i> (ground ivy)			April 8
59.	<i>Stachys sylvatica</i> (hedge woundwort).....		June 16	
60.	<i>Ajuga reptans</i> (creeping bugle)	May 9?	May 3	
61.	<i>Primula veris</i> (cowslip)		Mar. 14	April 5
62.	<i>Plantago lanceolata</i> (ribwort)		April 24	
63.	<i>Mercurialis perennis</i> (dog's mercury).....		Feb. 7	
64.	<i>Ulmus montana</i> (wych elm).....			Feb. 10
67.	<i>Orchis maculata</i> (spotted orchis).....	June 13		
68.	<i>Iris Pseudacorus</i> (yellow iris).....	June 12	June 14	
69.	<i>Narcissus Pseudo-narcissus</i> (daffodil)		Mar. 13	Feb. 24
70.	<i>Galanthus nivalis</i> (snowdrop)			Jan. 17
71.	<i>Endymion nutans</i> (bluebell).....	April 22		

The great amplitude in one species (*Geranium Robertianum*) calls for special remark. Its usual time of flowering is from about the end of April to the middle of May. We have the date May 20 for Watford. At Ware it was observed in flower a month earlier, and in Devonshire and Hampshire specimens were seen in flower early in February.* These early dates do not however show the true time of flowering of the species, but of a few plants only (as a

* 'Quart. Journ. Meteorological Society,' vol. iv, p. 56.

rule) which were brought into flower before their proper time by the mild winter, just as, when we have unusually warm weather succeeding colder late in the Autumn or early in the Winter, several of our spring-flowering plants may again come into flower. Such exceptional phenomena indicate abnormal states of the weather as surely as any meteorological instruments can do.

The results of the observations that have been made on the insects and birds, etc., must now be given. The initials used in the following summary refer to the observers already mentioned.

74. *Apis mellifica* (honey bee). Seen at Ware, Feb. 20—R. B. C.

77. *Epinephile Janira* (meadow-brown butterfly). Seen at St. Albans, June 11—J. H.

83. *Turdus pilaris* (fieldfare). Seen at Odsey, Nov. 6—H. G. F.

84. *Daulias Luscinia* (nightingale). Heard at Watford, April 15—J. H.; Amwell Bury, April 15—R. B. C.; Odsey, April 15—H. G. F.; Ware (numerous), April 24—R. B. C.

88. *Alauda arvensis* (skylark). Heard at Ware, Feb. 7—R. B. C.

90. *Corvus frugilegus* (rook). Building at Odsey, March 3—H. G. F.

91. *Cuculus canorus* (cuckoo). Heard at Watford, April 18—Lord Essex; April 19—J. H.; Odsey, April 19—H. G. F.; Ware, April 23—R. B. C. Changed its note at Watford, June 14—J. H.

92. *Hirundo rustica* (swallow). Seen at Watford, April 23—J. H. and J. King; Ware, April 26—R. B. C.; Odsey, April 29—H. G. F.

93. *Cypselus Apus* (swift). Seen at Watford, May 15—J. King; Ware, May 16—R. B. C.

97. *Rana temporaria* (common frog). Spawn seen at Ware, March 30—R. B. C.

Here we can only compare together and with the previous year the dates on which the nightingale's song and the cuckoo's note were heard and the swallow and swift were seen. The earliest dates are at Watford, but at Ware and Odsey the dates are usually only a day or two later. Compared with 1876, the nightingale was heard a week earlier in 1877, the cuckoo about two days earlier, and the swallow and swift at about the same time each year.

The appearance in unusual numbers of the clouded yellow butterfly (*Colias Edusa*) during the last few days of May only needs a passing mention here, having already been recorded in our 'Transactions' (Vol. I, p. 239).

15.—THE PHYSICAL CHARACTERISTICS OF MINERALS.

By JAMES U. HARFORD.

[A Lecture delivered 11th April, 1878.]

ABSTRACT.

THE word Mineralogy means strictly a discourse on matter found in mines; but, like many other terms of natural philosophy, has a more comprehensive application, and must be taken to include the inquiry into the character and properties of all materials which are found composing the crust of the earth. It addresses itself to the investigation of the laws, chemical, optical, and physical, of those materials.

It will be at once seen that the inquiry is of wide extent. The chemical laws prevail throughout the world of inanimate matter; thus Chemistry becomes a necessity in the complete study of the mineral world. Again, minerals are found in crystallised forms: so are other substances artificially produced; Crystallography is therefore brought into requisition. Again, many remarkable optical phenomena are exhibited by minerals; thus the science of Optics becomes necessary. And the same may be said in respect to Electricity and Magnetism. There are two ways of looking at the subject which will help us on this occasion. One is to take minerals as they are and submit them to the ordeal of our ordinary senses. Thus we attain to a knowledge of their *physical properties*. The other is followed by chemical decomposition and the application of chemical tests. Thus we determine their *chemical composition*. The former of these modes is followed in this lecture, and probably there is not a single sense to which appeal may not be made.

Smell.—This is a characteristic of many minerals, even in their natural state; such as sulphur and some of the carboniferous or bituminous group. When heat is applied, the smell of the fumes or vapour becomes powerful; but this test is beyond the limit of the present subject, and must be passed by.

Taste.—This distinguishes all minerals which are soluble, such as some metallic and earthy salts. Somewhat analogous to taste is adhesion to the tongue, which characterises some aluminous earths.

Feel.—This is somewhat complex, and requires practical illustration, involving the feel of minerals as rough, smooth, meagre, unctuous or soapy, dry, harsh, etc.;—all furnishing distinct characteristics of different minerals.

Hardness.—The hardness of minerals is a decisive characteristic, and a regular scale in ten gradations is agreed on by mineralogists for the purpose of ascertaining and recording this character. The softest mineral of the scale is tale, which may be scratched with the finger nail. The hardest known substance is the diamond.

Between these extremes all minerals may be classed in reference to their hardness.*

Weight.—This is a constant distinctive characteristic of minerals, and is reckoned by comparison with the weight of a similar bulk of distilled water. It is termed *specific gravity*.

While some minerals are lighter than water, and will consequently swim on its surface, the ordinary earthy minerals, such as stones, weigh about 2·6 times the weight of the same bulk of water. The metallic substances or ores are heavier, and culminate in gold, which weighs 19·3 times heavier than water. An intermediate place is occupied by the earthy mineral called baryta, the sulphate of which has a specific gravity of about 4·5, whereas that of sulphuret of iron (pyrites) is only 4·3. Baryta derives its name from its weight. In general the greater specific weight of a body indicates the presence of metal, and it is said that the sulphate of baryta has in this way been mistaken for white lead ore. Malleability, ductility, brittleness (distinct from hardness), flexibility, toughness, elasticity, are other characteristics of minerals, constant and uniform in their occurrence, and all serving to distinguish various mineral bodies.

Appearance.—The appeal of minerals to the sight is in various ways, their colour, lustre, transparency,—their metallic or non-metallic aspect,—their resinous, vitreous, pearly, chatoyant, silky, iridescent appearances. All these are worthy of remark and present characteristics of distinct minerals. The *streak* is important to be noticed, that is, the colour of the powder of the mineral produced by scratching. As an instance of this point may be mentioned the oxide of copper, which being grey in the natural state, becomes red when in powder. This causes the substance to be familiarly termed red oxide of copper.

Electricity and Magnetism afford characteristics that are important. As instances the diamond and amber may be mentioned. They become electric when rubbed. The magnetic ore of iron possesses the magnetic property in its natural state, and most ores of iron influence the magnet after being heated.

Crystallisation.—The tendency of divers minerals to assume regular geometric shapes is a conspicuous test of their nature. The dimensions of their angles of form may be reckoned with the utmost nicety. The simplest form, the cube, or perhaps the octahedron, or still more simply the tetrahedron, and the various forms related to them, form the class from which the phenomenon of double refraction is absent. When a ray of light passes obliquely through a transparent substance, it suffers refraction. If the transparent medium is a crystal of the cubic class of form, the refraction is single,—that is, the ray of light is undivided. When the crystal

* The scale is as follows :—

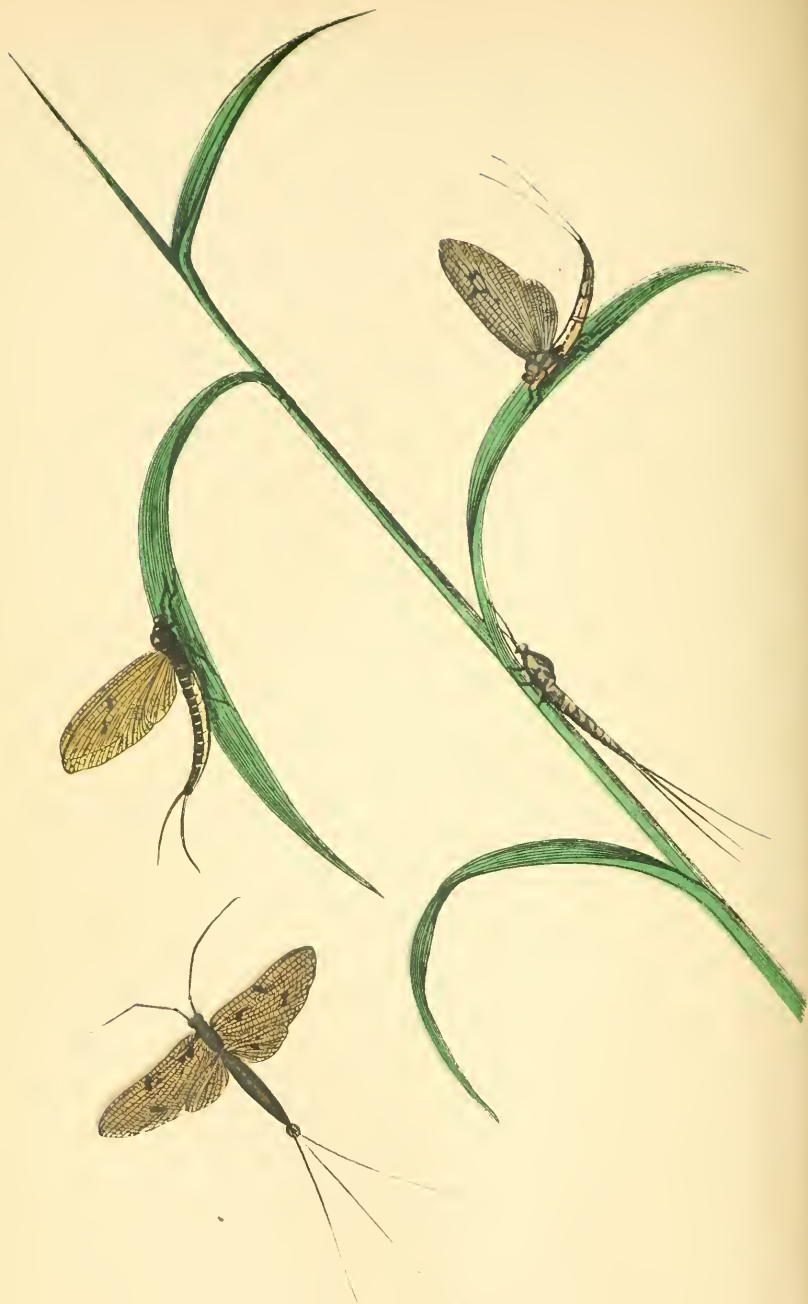
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|--------------------------------------|---------------------------------|
| 1. Talc, common foliated variety. | 6. Felspar, cleavable variety. |
| 2. Mica. | 7. Quartz, transparent variety. |
| 3. Calc-spar, transparent variety. | 8. Topaz, transparent crystal. |
| 4. Fluor-spar, crystallised variety. | 9. Sapphire, or corundum. |
| 5. Apatite, transparent crystal. | 10. Diamond. |

is of any other fundamental form than the cube, the ray of light traversing it is doubled, or divided into two, and these are polarised. That is, they possess properties that are alike in contrary or rectangular positions. This peculiarity is due to the polarisation of light, and cannot be here further noticed.*

Cleavage.—Somewhat analogous to the subject of crystallisation is that of cleavage. Many minerals split or divide into flakes in various ways, and with greater or less facility. Amongst the easiest to cleave may be mentioned mica, and all degrees of difficulty of cleavage may be observed in other minerals. Some minerals have but one plane of cleavage; others more, up to six, of which may be instanced the sulphuret of zinc or blende. The cleavage may be parallel to the natural face of the crystal, or otherwise, but always in accordance with a fixed rule.

Many other peculiarities of structure or texture in minerals may be noticed, all of which require illustration, such as radiated, as in the globular iron pyrites; massive or amorphous, as in native copper; fibrous, as in asbestos, tremolite, malachite, and satin spar; capillary, as in some specimens of native silver; lamellar, as in mica and talc; stalactitic, as in ordinary stalactites; granular, as in sandstones; botryoidal, as in ores of iron and in chalcedony; and many other features might be adduced to exemplify the varied face of natural productions.

* This subject has been treated of by Mr. Harford in a previous lecture. See 'Transactions,' Vol. I, p. 152.—ED.



THE MAY FLY.—GREEN AND GREY DRAKE.

(Ephemera vulgata.)

16.—NOTES ON THE MAY FLY.

By PETER HOOD, M.D.

[Read 13th June, 1878.]

PLATE I.

PERHAPS the most interesting of all our aquatic insects—to the fly-fisherman more especially—is the green drake or May fly—*Ephemera vulgata*—which belongs to the order *Neuroptera*, and the family *Ephemeridæ*.

This fly proceeds from a water nympha and lives as the green drake (the sub-imago state) for one or two days; then the female changes to the grey drake, and the male to the black drake. The green drake cannot be said to be in season quite three weeks on an average. Its season depends greatly on the state of the weather; and it will be found earlier on the slowly running parts of a stream (such as mill dams) than on the rapid places. The grey drake lives three or four days after her metamorphosis from the female green drake, and is caught by the fish whilst laying her eggs on the water. The term of existence of the black drake is about the same as that of the female. He is smaller than the female, and is erroneously supposed by some, who call him the death drake, to kill her.

It has been asserted by those who have devoted attention to the observation of the May fly, that exactly one year elapses, almost to a day, from the time the eggs are laid by her to the appearance of the flies on the water. That they do appear within a few days of this period there is no doubt, but the evolution from the larva state to that of the beautiful fly is much dependent upon the weather, and more especially also on the temperature of the water. I have not been able to ascertain at what period after the egg has been deposited by the female (which sinks like a shot to the bottom of the water) it is hatched, to form the larva, or maggot-like looking object, and I am afraid it may be long before such information reaches us. I extract the following from Ronald's 'Fly-fisher's Entomology' (p. 92), it being the most detailed account I have been able to obtain:—"The egg of this fly . . . sinks to the bottom of the water, and is there, in a few days, hatched into a white grig; this larva undergoes several transmutations before it becomes a nympha, which, rising to the surface at its appointed season, bursts the case or skin which encloses it (at the shoulders), displays beautiful wings, quits its old husk, and, after the lapse of a second or two, generally flies to the nearest *terra firma*, where it remains in solitude and shelter (from the wind and sun-beams) for about two days. It then undergoes its last metamorphosis, and enters upon its imago or perfect state, changing the whole of its envelopes, even those of its fine tails and legs. The tails and the two fore-legs of the male increase to about double their former length, those of the female receive an accession

of not quite one-third. The colour is generally altered, the wings becoming shining and transparent. The male carries two large stemmata upon his head, and a pair of callipers at the end of his body, which two peculiarities chiefly distinguish his appearance from the female. He is also usually rather smaller than she is. He may be seen merrily dancing, as it were, up and down in the air in vast crowds, frequently near a bush by the water-side, whilst the female is to be discovered busily employed rising and falling and hovering over the water, and sometimes touching the surface and making use of her long tails to spring up again. She lays her eggs at this moment." The egg itself is of infinitesimal size, and it may be that the rapidity of growth of the larva is out of all proportion to the dimensions of the cavity from whence it sprung. When the larva has attained a certain size, it changes to the caddis state, constructing a mansion for itself, by attaching small pieces of wood, straw, small stones, etc., and it lies concealed in this cylindrical habitation until the time arrives for its ultimate change.* On examining one of these objects the head will be observed slightly protruding, and a short pair of legs may be seen beneath the thorax—but these can only be observed when the caddis is not alarmed. It has the power of crawling and attaching itself to timbers, or large stones, and is seen on the gravelly bottom of rivers. Whilst in the caddis state trout and other fish will feed on it, swallowing it case and all, the gastric juice of the stomach digesting the contents of the case. Trout, more especially, may often be observed "feeding at the bottom," as fishermen call it, in shallow streams. Their tails will be out of water, whilst their heads are burrowing in the gravel for these and other insects. When thus occupied, the chances of catching fish are very small.

The May fly is common in the rivers that are unpolluted in the Midland, Western, and Southern counties. It is not so common in the North, and is rare and even unknown in many of the best rivers in Scotland, Ireland, and Wales. In Hampshire there is a celebrated club called the Houghton Club, which owns many miles of the river Test. This river is one of great purity, and the May fly is most abundant on it. The members belonging to the club assemble together for the express purpose of fishing during the "May Fly Season," which lasts for a fortnight, and it is a period of extreme enjoyment to them. They have a large tent erected on the bank of the stream, and they constitute a most agreeable party.

On the river Wandle, in Surrey, no May fly appears, but they have a fly on that water common also to others, which the fishermen call *their* May fly, which appears about the same time, but it is the alder fly or orl fly, which belongs to the same order, Neuroptera, as the genuine May fly. This comes also from a water nymph,

* This view of the metamorphosis of the May fly is not that generally held by naturalists, who believe the caddis to be the larva of *Phryganea* (and allied genera)—not of *Ephemera*. Izaak Walton, however, says that the May fly "is bred of the cod-worm or caddis," and this seems to be the general opinion of anglers.—ED.

but instead of laying its eggs in the water, it lays them on the leaves of trees which overhang the water. It is in season from the last week in May until the end of June. The river Wandle is mentioned by Izaak Walton in his book on angling, and he speaks of the trout therein as being the finest to be found anywhere. It is possible that they were so in his day, when the May fly might have been a denizen of those waters—from which subsequently pollution may have banished it,—but at present I think they are not entitled to this venerable and worthy fisherman's distinction.

When the May fly first comes to the surface of the water, it has to shake off the case that confines its wings, to dry them, and to gain a little strength in the new atmosphere it breathes, before it can fly to enjoy its short existence. It generally manages to shelter itself on a tuft of grass, when if the sun is shining it soon takes to flight and hovers over the water. It now becomes the prey of numerous birds as well as fish. I have watched the different kinds of birds that prey upon it, and it seems to them all a most tempting morsel. Swifts, swallows, martins, chaffinches, water-wagtails, starlings, and even rooks do not disdain to catch them when they are able. Perhaps the most amusing sight is to watch the common sparrow attack the May fly. His flight is a clumsy one, and he has no chance of securing his prey when on the wing; he therefore adopts a coarser but an effectual mode of capture. He flies sharply at the May fly, and butts it so as to knock it down, and then secures it. He takes care never to do this unless the fly is over a bank of weeds, or off the water, for he seems to know that if he acted otherwise, the fly would fall on the water and it would be beyond his power to secure it. I have seen the still parts of a river covered with the skins, or exuviae, of the May fly, and frequently have noticed trout rise at them when they have been floating down the stream, turning away from them, however, in apparent disgust when they have discovered their mistake in grasping at a shadow instead of a substance.

It would well repay any lover of the science of Entomology, who possessed an aquarium, to trace the history of the May fly from the egg. This might be done by obtaining some of the flies from the surface of the water whilst engaged in depositing their eggs, and removing them to the aquarium. The bottom of the aquarium should be composed of fine and coarse gravel, care being observed to exclude therefrom all insects, fish, snails, etc., that would be likely to prey upon the eggs, or larvæ, when hatched. In fact, the aquarium should be devoted exclusively to the occupaney of the May fly's eggs. An examination of the cases in which the caddis of the May fly is found would instruct the experimenter as to the various materials he should place at the bottom of the aquarium so as to be in readiness for the larva when it has arrived at a certain age of growth to construct for itself a habitation. As it is in streams and running water that the May fly deposits her ova, the tank in which the eggs are deposited should be constantly supplied with running water. If this experiment were carried

out, some most interesting facts might be obtained. Making allowance for the difference of temperature between the water in the aquarium and in a river, an approximation might be arrived at as to the length of time that occurred before the egg was hatched. When hatched, the changes that would take place in the larva, if any,—whether it in any manner resembled that of the silk-worm, with which we are familiar,—also the period that would elapse before the larva was of a size to construct for itself a home,—and how long it would remain a tenant of such home, anterior to its wonderful metamorphosis,—should be observed. Watching these various stages could not fail to be most interesting to the naturalist.

In connexion with the history of the birth and progress of the May fly to maturity, we are able to draw most important conclusions as to the condition of the water—its healthfulness or otherwise—on which she is found. No May flies will be discovered on streams that are polluted by sewage and other noxious elements. Many streams that have even been celebrated for the abundance of these flies are now no longer tenanted by them. This fact has excited a good deal of remark, and various opinions have been assigned for their disappearance. I cannot think there is any mystery or difficulty in explaining the true cause of their absence. If the bottom of a river is contaminated by materials that should never have been permitted to be passed into the stream, we cannot feel surprised at the tender egg of a May fly being poisoned and rendered rotten when it comes in contact with it—for it follows as a matter of course, that if the eggs deposited by the flies are not hatched there can be no May flies. That this is the true cause of the disappearance of this fly from many rivers, it is unfortunately too easy to prove. One of the most striking amongst them is to be found in the Colne at Rickmansworth. This river formerly abounded with May flies as well as trout; both have disappeared in consequence of the deleterious materials employed by Mr. McMurray, at Loudwater and Scott's Bridge Mills, which find their way into this portion of the river. The laws of nature are thus subverted in order to further the interests of man.

EXPLANATION OF PLATE I.

On the left-hand blade of grass is the female green drake, which changes into the grey drake on the right-hand blade, her cast-off pellicle being on the grass stem below. The flying insect is the perfect male, or black drake.

17.—MISCELLANEOUS NOTES AND OBSERVATIONS.

[Read 13th June, 1878.]

BOTANY.

Fertilisation of Aucuba Japonica.—At our June meeting last year a note by the Rev. R. H. Webb, M.A., relating to the fertilisation of this shrub, was communicated, in which he states that, although the female plant was introduced into this country about 95 years since, yet it was only within the last few years that the male plant was brought here.* I have been familiar with the female plant, which we used to call Cuba laurel, all my life; but I never saw the male till to-day. Two or three weeks since, I noticed five pretty, red, shining berries, oval, and about the size of peas, on a plant opposite my house. I have brought them on the branch for you to see, and also a small piece of the male plant. You will observe that the female plant is (as it should be) much prettier than the male, having larger leaves which are handsomely spotted, and that the male is small and inconspicuous. At first I could not understand how the laurel could bear fruit, as I did not know of any male plant in Watford. At last I found out that Mr. Humbert had a small male plant, situated 550 paces by the road from my house. Mr. Humbert has planted his male plant just under and contiguous to two fine female plants, and it is somewhat singular that my plant should be fertilised at this distance, whilst I could not distinguish a single berry on his trees. I should be glad if some of our entomologists would observe for me to what insect we are indebted for the fertilisation of the *Aucuba Japonica*.—*Alfred T. Brett, M.D., Watford House.*

ZOOLOGY.

Singular Disease amongst the Deer in Cassiobury Park.—In July, 1877, some of the fallow deer in Cassiobury Park were taken with a singular and fatal disease. They began by refusing food and drink. They seemed restless and agitated, running against trees, and they partially lost their power of walking, the hind legs being more especially affected. They died in from two to five days. The disease did not seem confined to any age, or sex, or condition, some of the finest bucks being taken. About this time rabies was supposed to be very prevalent, and two cases of hydrophobia had occurred near Watford. Some people, therefore, supposed from the symptoms that the deer were mad. There is no evidence of this. A *post-mortem* examination was made of one, and the disease was supposed to be inflammation of the membrane of the spinal cord. The disease has continued up to the present time, June 13th, and out of a herd of 300, about 80 have died. A similar disease occurred in the time of the late Earl of Essex, when

* 'Transactions,' Vol. I, p. 239.

out of a herd of 600, nearly 150 died; this was 70 years since. About 57 years since a similar disease also happened. The cause of the disease is obscure, and I have not heard of it in any of the neighbouring parks. In the 1821 epidemic, I am informed that Dr. Andrews (Mr. Ward's predecessor), Mr. Forsdyke, sen., and many others, ate the venison with safety. There is also a disease among the ewes at Cassiobury; and out of 150, over 40 have died. Lord Essex has had dead deer and dead sheep examined at the Agricultural College, Cirencester, and he has had elaborate reports sent him. These he has kindly lent me, and any one interested in the subject may read them. The opinion given is that the deer die of apoplexy from too good feeding.—*A. T. Brett.*

Natural Selection in Rabbits.—The doctrines of Darwin are so important to naturalists and biologists, that I think any fact that tends to confirm or refute them is worthy of notice: Mr. Jonathan King, of Wiggenshall, about 20 years since, had a wild grey rabbit which produced three black ones. These he had preserved, and now he has a large colony of black rabbits. He says that they never come piebald, and although the black and grey breed together, the offspring are always all black or all grey. This observation is different from the one recorded by Darwin in his charming book, 'A Naturalist's Voyage round the World.' He there says (p. 193) in speaking of the wild rabbits of the Falkland Islands: "The French naturalists have considered the black variety a distinct species, and have called it *Lepus Magellanicus*. The Gauchos laughed at the idea of the black being different from the grey, and they said that at all events it had not extended its range any further than the grey kind; that the two were never found separate, and that they readily bred together and produced piebald offspring. Of the latter I now possess a specimen, and it is marked about the head differently from the French specific description. This circumstance shows how cautious naturalists should be in making species, for even Cuvier, on looking at the skull of one of these animals, thought it was probably distinct." Besides the black variety of rabbits, Mr. King formerly had a breed of the silver-grey variety—black rabbits with white hairs, chiefly down the back. The late Mr. Nathaniel Hibbert, of Munden, also gave him a pair of white wild rabbits. These bred and continued as a colony for some time, but being so conspicuous by reason of their colour they met with many enemies, and they did not survive very long, dying out according to the law of the survival of the fittest. The black rabbits are now very numerous and outnumber the grey.—*A. T. Brett.*

18.—THE BULBORNE AND GADE, WITH NOTES ON THE FISH OF THE TWO RIVERS.

By JOHN E. LITTLEBOY.

[Read 14th November, 1878.]

“RIVERS,” says a Spanish proverb, “were made for wise men to contemplate, and for fools to pass by without consideration.” I am inclined to think that there is even more than a substratum of truth in the words I have quoted, and I hope that I need not apologise if I venture to detain you for a few minutes with a short description of the rivers Bulborne and Gade, before I attempt to enumerate the fish that frequent their waters.

That portion of the Chiltern Hills which extends from Wendover to Dunstable, and which becomes the north-western boundary of the county of Hertford, is remarkable as forming the watershed from which four distinct rivers—the Thame, the Ouzel, the Bulborne, and the Gade—take their rise. With the Thame, which rises on the opposite side of the hills, only a few miles distant from what was once the source of the Bulborne, and which, after watering the Vale of Aylesbury and passing the town of Thame, discharges itself into the Isis a few miles above Wallingford; and with the Ouzel, which rises, in similar fashion, a few miles north of the source of the Gade, and, after passing Leighton Buzzard, falls into the Great Ouse at Newport Pagnell, we, as a Hertfordshire Field Club, have but little or nothing to do.

The Bulborne and the Gade are essentially Hertfordshire streams; they rise in Hertfordshire, throughout their entire course they wash the soil of our county, and the latter effects a confluence with the waters of the Colne just within its limits. The Bulborne is thus described by Chauncy: * “The Bulbourne; rising in the Parish of Tring, and running by the Frith called Parkhill, thro’ Pendley Wyer and Penley Moore, goes to a place named Dagnalls” (which name I believe to be a mistake); “thence hastening thro’ Albury Meads and Dudswell Bottom, falls away by North-Church, and washing the North East Side of Berkhamsted, is encreased by the assistance of two Springs;” etc.

In the year 1700, which was, I believe, about the period at which Chauncy wrote, this description was doubtless a correct one. All the old maps which I have been able to consult describe the Bulborne as rising as high or higher than Park Hill, the point mentioned by Chauncy, and in most of them a branch is also shown as rising somewhere near Aldbury, and joining the Bulborne between New Ground and the Cow Roost.

It is remarkable that at present there appears to be no trace of the Bulborne above the Cow Roost, and, although it is still possible to follow what was once a watercourse along some portion of the

* ‘Hist. Antiq. Herts,’ vol. i, p. 4 (reprint, 1826).

Aldbury meadows, it but rarely happens that any water is to be found, and even in the wettest seasons no current is perceptible. The Dudswell meadows may fairly be considered as the present source of the Bulborne, and, as Dudswell is three miles nearer London than Park Hill, it is evident that the little river has ceased to flow over at least that distance of its former course, and also that the feeder from Aldbury has altogether disappeared. This alteration must of necessity have been caused by a permanent depression of the plane of saturation in the surrounding Chalk formation, and it is more than possible that it has resulted from the cutting of the Grand Junction Canal and the artificial drainage thereby created. If I am correct in this hypothesis, I am afraid that it affords a rather ominous prognostication of the possible effect of the operations of the Colne Valley Waterworks on the waters of the Ver and Colne.

The Bulborne, after rising, as I have said, in the Dudswell meadows, pursues its course onwards by Northchurch to Berkhamstead, as lively a little stream as ever invited the tarriance of trout or grayling. Below Northchurch the development of the trade in watercresses has told its tale upon the river; wherever a tributary spring could be detected, or in places where it has been found practicable to divert a portion of its current, large artificial watercress beds, extending over many acres, have been laid out and planted on what was formerly meadow land, and I am informed that the breakfast tables not only of London, but of Liverpool, Manchester, and the large Yorkshire towns, are daily supplied with cresses, the produce of our little Bulborne.

The growth of watercresses in this district has, no doubt, been fostered to a large extent by the equable temperature of the stream. Issuing from the base of the Chalk hills but a few miles distant, and constantly receiving additional supplies from a similar source, the water of the Bulborne but rarely freezes, and even during the heat of summer it possesses a most agreeable and refreshing coolness.

At the top of Berkhamstead, about halfway between the river and the turnpike road, St. John's Well—a spring that bubbles up under cover of a little shed near the spot where once stood the Hospital of St. John the Evangelist, founded in the reign of King John by Geoffrey Fitz-Piers, Earl of Essex, for the cure of lepers—discharges, down the side of the lane that derives its name from the well, a constant supply of sparkling water, as delicious in flavour as ever

“Babbled over pebbles.”

Unfortunately for Berkhamstead it is not allowed

“To join the brimming river”

in its unpolluted state, but is made the vehicle for receiving a large portion of the drainage from the upper part of the town. It renounces almost immediately the patronage of the Evangelist, and under the very appropriate soubriquet of the “Back or Black

Ditch," pours into the Bulborne above the upper mill as foul a current of mephitic abomination as ever defiled a watercourse.

At Berkhamstead the course of the Bulborne becomes incorporated, for the first time, in that of the Grand Junction Canal. The upper and lower mills on this river are mentioned by Chauncy as being, in the year 1271, of the annual value of £6 13s. 4d. each, and are probably about as ancient as any existing in the district.

From Berkhamstead the Bulborne wends its way along the meadows of a beautiful valley, and, passing Bourne End—where it receives the intermittent outpour of the Hertfordshire Bourne, so well described by Mr. Evans in a paper read about two years ago before the members of this Society*—it crosses Boxmoor, and eventually joins the Gade above the paper mill at Two Waters.

And now a few words about the Gade. As far as I have been able to ascertain by a careful reference to sundry old maps, the source of the Gade has varied but very little for several centuries. Neither railway nor canal has ever yet intruded upon its secluded haunts, or ventured to interfere with the quiet operations of Nature. As the name implies, it rises in the parish of Great Gaddesden, in ordinary years at a point not far distant from the church, but in wet seasons it occasionally makes its appearance considerably higher in the valley. In the month of February, 1877, a strong spring burst out from the side of the hill near the Lambsey homestead, and flooded the Dagnall road for nearly a mile.

The head of the Gade is about five miles distant from the source of that branch of the Ouzel which rises near Totternhoe, and about four miles from that of the Bulborne at Dudswell. After leaving Great Gaddesden and passing the picturesque hamlet of Water End, the Gade pursues its course along the valley of Hemel Hempstead by Marlowes to Two Waters. At Two Waters it more than doubles its volume by a confluence with the Bulborne, and, passing onwards by Nash Mills, King's Langley, Hunton Bridge, Cassiobury Park, and Croxley Hall, falls into the Colne a little above Rickmansworth. Mr. Evans considers that the valleys of the Bulborne and the Gade were both mapped out in a pre-glacial period, but it is probable that the gap in the Chalk hills at Dagnall, and the depression in the same formation at Park Hill, near the Tring railway station, are due, at any rate, in some degree to the chemical dissolution and abstraction of the chalk by the four rivers which take their rise in the two localities.

In order to demonstrate that this process is still in active operation, I have attempted to gauge the quantity of water which passes down the Gade at Hunton Bridge, and I think that it cannot average less than 30,000 gallons per minute. Professor Attfield, who has kindly assisted me by analysing a portion of this water, and also by sending me an analysis of some water taken from a well which is sunk in the neighbouring chalk, informs me that

* 'Transactions,' Vol. I, p. 137.

every gallon of the river water contains about twelve grains of carbonate of lime, and six grains of other calcareous matter. The whole of the carbonate of lime, together with a small portion of sulphate, is precipitated by boiling, and this fact will explain the origin of the incrustation that accumulates in culinary utensils in which such water is boiled. It follows, therefore, if my calculation of the volume of water passing Hunton Bridge is correct, that an aggregate quantity of more than 18,000 tons of chalk is annually abstracted from the surrounding Chalk formation and carried away by the water of the Gade, to be again precipitated, or, by the organic agency of minute Foraminifera, to form, in some far-off submarine region, a new Cretaceous deposit, possibly the incipient chalk hills of ages yet to come. I find, by reference to Professor Attfield's analysis, that a gallon of water taken from the chalk well to which I have alluded contains six grains of calcareous matter over and above the quantity found to exist in water taken from the Gade; but this is easily accounted for by the large quantity of surface drainage which that river receives during its course downwards, the water springing from the Chalk formation becoming, in this manner, more or less diluted.

I extract the following sentence, which seems so aptly to bear on this subject, from Mr. Evans' work on 'Ancient Stone Implements' (page 591):—"Taking the calculation of 17 grains of bicarbonate of lime to the gallon, it will be found, by calculation, that every inch of rain which falls over a square mile of chalk country, and passes off by springs, carries with it, in solution and without in the slightest degree interfering with its brightness, no less than from 15 to 16 tons of solid chalk."

I now proceed to the consideration of the second portion of my subject, viz. the different varieties of fish which frequent the two rivers I have attempted to describe.

Baron Cuvier has divided all fishes into two great series: 1st, the Osseous Series, or those which possess a bony skeleton; 2nd, the Cartilaginous Series, or those which possess a cartilaginous skeleton. He further subdivides these series into six orders, based principally on the nature and texture of the fins, four belonging to the osseous and two to the cartilaginous series.

Into the particulars of these divisions I do not propose to enter. All the fish which are likely to claim our attention this evening, with the single exception of the lamprey, belong to the first or osseous series.

I have already stated that the rivers Bulborne and Gade become incorporated, at different times, with the Grand Junction Canal. It is therefore necessary, when considering the fishes of the two streams, to include all those which have been taken or observed in that portion of the canal through which they pass. I shall commence with the smaller varieties.

THE THREE-SPINED STICKLEBACK (*Gasterosteus trachurus*).—First upon my list is the rough-tailed, or three-spined, stickleback, and in several respects this tiny creature ranks amongst the most

interesting and intelligent of its class. It appears to be instinctively pugnacious, and, being armed on the back with three sharp spines, which it can raise or depress at pleasure, it is able to protect itself, in no inconsiderable degree, from the attacks of other fish.

Sticklebacks are extremely tenacious of life, and may be kept in glass tanks or globes with little or no difficulty. When thus held in captivity, it is often very amusing to watch their proceedings. One of the little tyrants will frequently attempt to appropriate a particular portion of the water for his exclusive use, and when this is the case, woe to the unfortunate intruder that happens to invade his territory. A battle royal is almost certain to ensue, and, not content with the victory, the conqueror will still continue to chase his victim about the tank in the most relentless manner. It is stated by a writer in the 'Magazine of Natural History,'* that he once saw a stickleback, during a battle of this description, which took place in a wooden tub, "absolutely rip his opponent quite open so that he sank to the bottom and died."

Sticklebacks are abundant almost everywhere, and the Gade is no exception to the general rule. Any of my audience who may incline to test their pugnacious capabilities, by placing a walking-stick in the middle of a small shoal of them, will find that the little warriors commence almost immediately to charge the stick with such fury that their attacks are distinctly perceptible to the hand. The stickleback is distinguished, among English fishes, by its capacity for nest-building. Those who incline carefully to watch, during the months of April or May, a gravelly reach of the Bulborne or the Gade, can hardly fail to witness this very interesting operation. The tiny fish appear to collect small pieces of stick, wet moss, or weeds, and by inserting these among minute particles of sand and gravel, a nest is at last completed that may frequently be lifted out of the water without a collapse; it is about the size of a shilling, and the ova are deposited in it through a hole left at the top.

THE MINNOW (*Leuciscus Phoxinus*).—With the exception of the stickleback, the minnow is the smallest of our English fish, and to this fact it is probably indebted for its name. When in good condition it is extremely handsome, its back and sides generally assuming a dusky olive colour, but when seen in a favourable light appearing to be exquisitely shot with blue, its belly also varying from a brilliant red to yellow, and frequently to a pearly white.

The minnow is invariably found to put in an appearance not later than the month of March, and continues more or less abundant till the approach of winter. During the winter months it is rarely to be met with, and is supposed to betake itself for protection and shelter to the roots of weeds, to the banks of the streams that it frequents, and to other hiding places; it is easily tamed, and, when kept in a glass globe, will feed readily from the hand.

* As quoted by Yarrell, 'British Fishes,' vol. i, p. 78.

Minnows are considered by connoisseurs to be very palatable. The following receipt for cooking them is given by Izaak Walton; it may possibly interest our lady members:—"Let the fish be gutted and well washed in salt and water, cut off both heads and tails, then fry in good butter, adding to it the yoke of eggs in which the flowers of the cowslip and primrose have been well beaten." When thus cooked they are said to equal or even excel the whitebait.

THE LOACH (*Cobitis barbatula*).—Although not particularly abundant, the loach is a constant frequenter of our streams. It but rarely rises to the surface of the water, and appears to prefer a hiding place by the side or under the shelter of stones. Like many of the Carp family, the body of the loach is invested with a thick mucous secretion, and, in common with the barbel and gudgeon, it possesses a fringe of barbules round its mouth. It is about three inches long, its mouth is small, and it has no teeth. Mr. Yarrell informs us* that the loach appears to be particularly restless and sensitive before a coming storm, and that in olden times it was commonly preserved in vessels as a living barometer. I may also state on the authority of the same author that all ground fish—and those furnished with barbules may invariably be classed under this head—possess but a low standard of respiration and a high degree of muscular irritability, and that the restless movements of the loach during a thunderstorm must be attributed to its great susceptibility to any change in the electrical conditions of the medium in which it moves.

The loach, like the minnow, is considered by many to be a dainty. It is occasionally preserved in the same manner as anchovies, and has frequently been transported by amateurs to different parts of Europe.

THE MILLER'S THUMB (*Cottus Gobio*).—The river bullhead, or miller's thumb, is a small dark-coloured fish from three to five inches long. It is an ugly disagreeable-looking creature, its head and mouth being disproportionately large, and the latter thickly set with minute spiny teeth. It prefers to frequent gravelly streams, keeps close to the bottom, and, generally hiding beneath the shelter of stones, is but very rarely observed.

The head of the fish, says Mr. Yarrell,† "is said to resemble exactly the form of the thumb of a miller, as produced by a peculiar and constant action of the muscles in the exercise of a particular and most important part of his occupation." One shrinks from questioning, even in the smallest degree, the authority of Mr. Yarrell, but to this anecdote I am inclined to add the remark, "Interesting, if true."

THE GUDGEON (*Gobio fluviatilis*).—The gudgeon is very abundant both in the Bulborne and the Gade. It is a pretty little fish, three to five inches in length, is furnished with a short barbule at each angle of its mouth, and is of an olive-brown colour, spotted with black.

* 'British Fishes,' vol. i, p. 377.

† *Ib.* vol. i, p. 57.

Gudgeons are, in habit, gregarious, and during the early spring large shoals of them frequent the waters of the Gade at Hunton Bridge. When watching them from the little bridge that crosses our waste-water, I have often noticed that the gravelly bottom of the stream was completely obscured by them, any attempt accurately to estimate their number being altogether impossible. Intermixed among the gudgeons, immense numbers of minnows are frequently observable; they swim about together in an apparently indiscriminate manner; but when disturbed, the gudgeons will almost always sail off in one direction, while the minnows select another. The gudgeon is rarely to be met with during the winter months. Mr. Rooper, as stated in his interesting work, 'The Thames and Tweed' (p. 27), believes that they retire to deep holes, probably remaining during the winter in a semi-torpid state.

Every one tells me that when cooked properly the gudgeon is a *bonne bouche* not to be surpassed by any freshwater fish. I am sorry to confess, notwithstanding the thousands that frequent our stream, that I have never yet tasted one.

THE BLEAK (*Leuciscus Alburnus*).—I have not been fortunate in meeting with this little fish in the neighbourhood of Hunton Bridge, but I am informed that it is abundant below the Swiss Cottage, and I believe that it is yet to be met with above Berk-hampstead. The bleak has frequently been described as the freshwater sprat; it is a lively, active little creature, and affords excellent practice for the youthful fly-fisher. In appearance it somewhat resembles the dace, but is smaller and more slim than the generality of that species, and can readily be distinguished from it by the backward position of the dorsal fin, and its more decidedly swallow-shaped tail. The prevailing colour of its back is a light green, but its sides and belly are of a shining silvery white.

The bleak is esteemed as a delicacy for table use; but in olden times it was considered to be especially valuable as affording a *matériel* for the manufacture of artificial pearls. Mr. Yarrell describes this manufacture as follows: * "On the inner surface of the scales of roach, dace, bleak, whitebait, and other fishes, is found a silvery pigment, which gives the lustre these scales possess. Advantage has been taken of the colouring matter thus afforded to imitate artificially the Oriental pearl. . . . The method of obtaining and using the colouring matter was, first carrying off the slime and dirt from the scales by a run of water; then soaking them for a time, the pigment was found at the bottom of the vessel. When thus produced small glass tubes were dipped in, and the pigment injected into thin blown hollow glass beads of various forms and sizes." So great was the consumption of bleak scales for this purpose, that one Paris manufacturer is stated to have used in the course of a single winter thirty hampers of bleak.

* *Ib.* vol. i, p. 369.

If Dr. Lister, on whose authority this statement is made, had been good enough to mention the size of the said hampers, a better estimate of the total quantity consumed might certainly have been formed.

THE DACE (*Leuciscus vulgaris*).—The dace is one of the most abundant and universally distributed of English fishes. At Hunton Bridge we have literally thousands of them. They appear to be always on the move, and shoals of them may constantly be seen parading our watereourses. Dace will frequently rise to an artificial fly, and during the past summer I have seen many of them taken in this manner. They spawn in the months of May and June, and during the past six weeks myriads of the small fry, three-quarters of an inch to an inch in length, might be observed in our stream.

THE ROACH (*Leuciscus Rutilus*).—Similar in general appearance to the dace, and its almost constant companion, is the roach. Both these fishes are gregarious, and, as far as I have been able to observe, they fraternise with each other on the most amicable of terms. A shoal of dace can rarely be found without having amongst its number a considerable proportion of roach, and the converse position of affairs is, I believe, equally general.

The roach is, generally speaking, both larger and coarser than the dace; it is deeper in the belly, and its back is more decidedly convex. It is stated that roach weighing as much as two or three pounds have been occasionally caught in the Thames. Mr. Rooper reports having landed one that weighed a pound. I believe that in the Bulborne and Gade they but rarely exceed eight to ten ounces.

THE CHUB (*Leuciscus Cephalus*).—But few chub are to be met with either in the Bulborne or the higher reaches of the Gade; they appear to become more numerous as the river increases in volume, and below King's Langley they may be observed in large numbers. Except when basking on a shallow, they prefer to frequent the deeper portion of the stream, but they rise greedily to a large fly or cockchafer, and though very inferior in pluck and activity to the trout, will often afford considerable sport to the angler.

Chub weighing from two to three pounds have frequently been taken from the Gade at Hunton Bridge, and if we may believe the newspapers, a six-pounder was recently captured at Lady Capel's wharf.

Dace, roach, and chub are often to be seen swimming about together, but it is easy to distinguish the one from the other by their colour. The tails and fins of the dace are of a light self-colour, nearly matching the colour of the water; those of the roach are distinctly tinted with red, and those of the chub are much darker than those of either of its companions. It may also be noted that dace are generally observable near the surface of the water. The roach occupies a middle position, and the chub, as I have before said, affects deeper water.

The chub is a coarse, plebeian-looking fish, with a large clumsy head: a fine specimen, weighing about 4lbs., has been kindly lent for exhibition by Mr. Moon.

I have already alluded to the nests of the stickleback. This pretty little creature appears to surpass all its fellows in the art of nidification; but it is well known that the chub, the dace, the roach, the trout, and several other fish carefully prepare their spawning-beds. All who have strolled along the banks of the Gade during the spring months must have noticed that the gravelly bottom in certain portions of the stream was completely laid bare and almost ploughed into ridges. These ridges are the work of the fish that I have just mentioned. I believe that they are made principally by the female, and that she accomplishes this engineering feat by the vigorous action of her tail; after depositing her ova, she is said* to throw herself on her side, and, by a renewed action of the tail, effectually to cover them. The extraordinary quantity of the ova thus deposited is graphically described by Mr. Francis.† He states that during the month of May a shoal in the Thames near Marlow was completely blackened by a shoal of large fish engaged in depositing their spawn. As soon as the fish left, a troop of about five-and-twenty swans, led by a patriarchal old villain, came sailing up the river, and immediately commenced ripping up the spawning-beds and devouring the spawn. For ten days these swans gorged themselves to repletion night and day, and, "I believe," says Mr. Francis, "that they must have devoured in that time a small boat load of spawn."

THE PERCH (*Perca fluviatilis*).—With the exception of the trout, the perch is decidedly the most handsome and distinguished in appearance of all our fresh-water fish. Like the chub, it prefers deep water, and as it slowly floats along the bottom, it presents to the observer, with its beautifully-striped zebra-like body and sharp prickly fins, as striking and interesting a picture as our streams can anywhere afford.

The perch is abundant in most rivers; at Hunton Bridge it attains a considerable size, and I venture to direct your attention to two fine specimens taken last winter, within a stone's throw of my garden. Mr. Rooper records a very curious fact in reference to this fish. He writes as follows:‡—"I have hardly, if ever, opened a fish that did not prove to be a female, and, at whatever time of the year, always with spawn fully developed, yet the spawning time of the perch is in April or May."

THE RUFFE (*Acerina vulgaris*).—Closely allied to the perch, but smaller, and distinguished from it by the brown spots that abound on the upper portion of its body, and by its continuous dorsal fin, is the ruffe or pope. I have never seen a specimen of this fish, but Mr. Fry informs me that he has succeeded in capturing several.

THE BREAM (*Abramis Brama*).—I believe that this fish is only

* Hamilton, 'British Fishes,' vol. i, p. 101.

† 'Fish Culture,' p. 203.

‡ 'Thames and Tweed,' p. 51.

to be met with in the lower reaches of the Gade. I am fortunate in being able to exhibit two good specimens, which have been recently taken. It will be observed that, in appearance, the bream is by no means elegant, the lines of both the back and the belly being unusually convex.

The bream is supposed to find its most congenial habitat in ponds and muddy rivers. It is possible that the few which are occasionally taken in the clear waters of our gravelly Gade may have found their way upwards from its junction with the Colne. A remarkably fine bream, 5lbs. in weight, was successfully landed not long since by Mr. Moon; another, weighing 3lbs., by Mr. Fry.

THE TENCH (*Tinca vulgaris*).—This coarse sleepy-looking fish frequents, for the most part, pits, ponds, and dull sluggish streams with muddy bottoms, and were it not that the Bulborne and the Gade become, at different places, incorporated in the pounds of the Grand Junction Canal, it is hardly probable that the tench would have been counted among their fishes. I am informed that at Boxmoor tench are tolerably abundant, and two were recently taken at King's Langley.

Most of my audience will have heard of a curious tradition which for hundreds of years past has surrounded the tench with a halo of mysterious interest. This fish was believed by the Romans to possess curative properties of an extraordinary character; not only was it supposed to act as a physician among its fellows, but its healing qualities were believed to be applicable to mankind. I find it recorded that the Jewish physicians, who formerly practised at Rome, were accustomed to apply a tench, cut open, to the feet of patients suffering from fever; but whether the treatment was found to be efficacious I know not. I believe it to be a fact that for some unexplained reason the tench is invariably allowed to pass unmolested by other fish; but whether it enjoys this immunity from a devout respect engendered by the exercise of healing power, or, as is more probable, from a dislike to the slimy mucus with which its body is enveloped, I cannot pretend to say. I have seen it stated in a periodical that "a trimmer, baited with a small tench, may remain night after night in the most favourable locality without attracting the attention of either pike or eel." The following rhymes are extracted from 'The Piscatory Dialogues of Mr. Diaper':—

"The Pike, fell tyrant of the liquid plain,
With ravenous waste, devours his fellow train;
Yet howsoe'er he be with famine pined,
The Tench he spares, respectful to his kind.

"For when by wounds distressed, or sore disease,
He courts the salutary fish for ease,
Close to his scales the kind physician glides,
And sweats a healing balsam from his sides."

THE COMMON TROUT (*Salmo Fario*).—Forty years ago trout abounded both in the Bulborne and the Gade. In the upper reaches of the Bulborne, between Berkhamstead and Bourne End,

and again at Boxmoor, I remember them being taken by expert anglers in abundance. As a boy I have often captured several brace, in a few minutes, by wading in the river below the Bourne End Mill, and feeling for the fish with my hands in the holes and crevices of the walls and woodwork. At present I am afraid there are but very few remaining in the localities I have mentioned, several causes having combined to assist in their extermination. The large artificial watercress-beds below Northchurch, affording, as they do, constant employment to numbers of working men, in close proximity to the river, are probably by no means favourable to the preservation of trout. At Berkhamstead the population has of late rapidly increased. The Back Ditch, to which I have before alluded, pours its load of drainage into the Bulborne at the upper mill, and I am informed by its occupier, Mr. Cook, that not only fish, but even ducks are poisoned by it. Excepting the grayling, the trout is the most sensitive and delicate of fish, and its absence from this portion of the river is thus readily explained. I believe there are a few yet to be met with about Bourne End and Boxmoor; but even in the most favoured reaches of the river their number is very limited. The upper portion of the Gade, extending from Great Gaddesden to Marlowes, and traversing the properties of Lord Brownlow, Mr. Halsey, Sir Astley Cooper, and others, is strictly preserved; and were it not for the privileged efforts of a few inveterate anglers, these charming waters might well constitute for the trout a very paradise. The drainage from the town of Hemel Hempstead does not appear to be so destructive to the trout of the Gade as is that of Berkhamstead to those of the Bulborne; at Marlowes there may still be seen a fair quantity of beautiful fish, but very few are to be met with below the paper mills. A trout weighing $7\frac{1}{4}$ lbs. is reported to have been taken some years ago at Nash Mills. At Hunton Bridge the trout of the stream were formerly carefully preserved by Mr. Carpenter, and until recently five or six very fine ones, weighing from 2 lbs. to 4 lbs. each, were almost always to be noticed at the foot of the water-wheel. They were extremely tame, and would often leave their shelter to be fed. Shall I be believed when I state that they were stolen by a person who called himself a gentleman, and to whom, after pointing them out, I had given permission to fish in another part of the stream?

During last autumn two fine trout, weighing $6\frac{1}{4}$ and $6\frac{3}{4}$ lbs., were taken in the canal, close to Hunton Bridge; and through the kindness of my neighbour, Mr. Burbidge—to whom I am also indebted for my other stuffed specimens—I am pleased to be able to exhibit them. They are, I believe, the largest fish which have been taken in our portion of the river. Several years ago Mr. King, of Wiggenhall, kindly presented me with about three hundred tiny young lake trout; I turned them into a run specially prepared for them, and paid them every possible attention; but notwithstanding this only a few dozen survived, and when about four inches long almost all of them escaped into the stream. I have never since been able to identify any of them, but it is very

probable that the two now exhibited may have descended from them. In both the Grove and Cassiobury Parks the trout of the Gade are again carefully preserved. At the Swiss Cottage they are abundant, and to lovers of Natural History, the delight of watching them, with their beautifully spotted sides, as they dart with the rapidity of an arrow through the clear waters of the Gade, constitutes at all times an absorbing object of interest, even among the many attractions of that charming retreat. I am inclined to think that it is impossible to observe the habits and movements of the trout more advantageously than may be done during a rise of the May-fly in this portion of the Gade. The May-fly supplies to the trout the most attractive of baits, and as it floats along the surface of the water, after commencing its short-lived existence, it is sucked under with the utmost avidity by these greedy creatures.

Before I bid adieu to the trout I will venture to relate an occurrence of which I was an eye-witness. A friend of mine residing at High Wycombe succeeded in taming a fine trout. He was constantly in the habit of feeding it, and it became so tame that whenever he made his appearance it would approach the bank. We thought that we would test its capacity, and we therefore supplied it with a constant succession of medium-sized frogs. It did not allow them a moment's respite; the instant they touched the water, there was a huge plunge and they were gone. In this manner twelve were devoured without the smallest hesitation; the thirteenth was played with for a few minutes, but eventually demolished. It was necessary to draw the line somewhere, and the fourteenth was allowed to reach the bank in safety.

THE PIKE (*Esox Lucius*).—The pike or jack is the largest of fresh-water fish. It is abundant in every stream, and is so universally known and easily recognised that I need not detain you by describing its appearance. It is an extremely voracious fish, greedily devouring, when hungry, almost anything or everything that comes within its reach. It has frequently been termed—it seems to me very appropriately—the “fresh-water shark.” Schiller, in one of the most beautiful of his ballads, has described the shark as

“The hyæna of Ocean,”

and I think my hearers will allow that the pike is a fitting representative of its prototype.

Two years ago a gentleman at Hunton Bridge succeeded in landing a pike that weighed 11 lbs. On being opened by the cook it was found to contain a moderate-sized water-rat, which had been swallowed whole, and, except that it was dead, it had suffered but little in appearance from its fatal adventure. On another occasion a pike was captured, in the stream that divides our garden, with a second pike only a little smaller than itself in its mouth. It was quite unable either to swallow or disgorge its victim, and when taken out of the water was as nearly dead as possible.

Mr. Rooper describes an occurrence which places the frog anecdote I have just related altogether in the shade. He writes as follows* :—“A gentleman who has no wish to communicate his name to the Society for the Prevention of Cruelty to Animals, once threw thirty young sparrows and starlings, one after the other, to a large pike in a lake, and he seized and swallowed the last with as much avidity as the first.” Notwithstanding the gross appetite of the pike, he appears equally to appreciate more delicate morsels. He will seize young ducks when swimming on the stream, pull them under in a moment, and instantly devour them. I have lost many of my own ducklings in this manner. The pike is said to grow at an unusually rapid pace; he will attain to the length of eight or ten inches in his first year, and will grow at the rate of 4 lbs. per year for six successive years.†

As far as my own experience will guide me, I am inclined to think that the pike of the Bulborne and the Gade attain to a greater size at present than they did forty years ago. Is it possible that the garbage which drains from our towns and villages, so fatal to the existence of the delicate trout, affords a very congenial food to the omnivorous pike?

THE COMMON EEL (*Anguilla acutirostris*).—Eels are tolerably abundant in both the Bulborne and the Gade, but they prefer muddier streams, and are, I believe, far more numerous in the adjacent Colne. At Hunton Bridge, eels weighing as much as three and three-and-a-half pounds have not unfrequently been taken. Every one knows the distinguishing characteristics of the eel. The words “as slippery as an eel” have passed into a proverb, and its extraordinary tenacity of life is equally notorious. It is probable that it may owe the latter characteristic to its semi-amphibious qualities. If kept in a damp place, it will live, out of water, for several days; and the fact that it will occasionally leave the water and cross the damp grass of a meadow to a distant pond is, I think, generally admitted.

In describing the loach I have already mentioned the extraordinary muscular irritability which distinguishes ground fish. This is the case to a very remarkable extent with the common eel, and is said to explain its acute susceptibility to the influence of atmospheric electricity. During a thunderstorm eels always display the greatest activity, and it is a curious fact that on these occasions they invariably “run” “down stream.” It is conjectured that they do this to secure, if possible, the safety of deeper water; but the event is often found to falsify the anticipation. At most of the dams and sluices on rivers in which eels abound, traps are provided for catching them, and their career down-stream is suddenly arrested by these fatal contrivances. At mill-dams on the Thames large quantities of eels are often enough taken in a single night; and our President in his paper read last year

* ‘Thames and Tweed,’ p. 58.

† Hamilton, *loc. cit.* vol. ii, p. 80.

reported a take of three-hundred weight on one occasion at the Watford Mill.*

The eel was formerly supposed to supply a connecting link between serpents and fishes. They are in reality perfectly distinct; the skeleton and internal organs of the two animals differing in essential particulars. The following anecdote, the correctness of which I can positively answer for, seems to indicate that it is even yet possible to mistake the one for the other. A gentleman, residing near London, possessed and petted two foreign snakes. One morning both of them were missing, and, much to his chagrin, could never again be found. Some days afterwards he accidentally heard of an extraordinary incident which had occurred next door. Two live eels had appeared, so it was asserted, much to the astonishment of the cook, upon the kitchen sink. His neighbour informed him that he supposed they must have found their way up the drain. "But," said he, "they were remarkably fine ones; we had them cooked for dinner, and they turned out delicious." Probably the advent of the two eels upon the kitchen sink of the one house will satisfactorily explain the simultaneous disappearance of the two tame snakes from the adjoining establishment. Surely there is abundant truth in the old English proverb—"Where ignorance is bliss 'tis folly to be wise."

THE LAMPERN OR RIVER LAMPREY (*Petromyzon fluvialis*).—I have been able to obtain but little information respecting this ungainly and worm-like-looking fish. I believe it to be tolerably abundant in the Gade. Two years ago a small lampern found its way through the iron pipe that supplies water to my fernery, and remained in the little basin for several days; on one occasion, when disturbed, it left the water and attempted to climb the stones which form the small rockwork, and at last managed completely to hide itself from observation. Whether it succeeded in reaching the canal I cannot tell, but I never again saw it. At Cassio Bridge the lamprey is abundant. Groups of more than a score may sometimes be seen in the watercress-beds of that locality; they appear to fasten themselves to the bottom by suction, and their bodies wriggle about in continuous motion. Thames lamperns were formerly sold to Dutch fishermen, by the thousand, as a bait for cod, turbot, and other fish.

Crayfish and mussels do not belong to the class now under consideration, the former is a crustacean, the latter a mollusc; but while treating of the Natural History of the Gade, perhaps I may be allowed to state that, during the past summer, crayfish have been unusually abundant in the stream at Hunton Bridge. Our table has on more than one occasion been ornamented with a handsome dish of them, and a more delicate relish it is difficult to meet with. I may further state that whenever the water of the canal is drawn down a large quantity of mussels is always to be found. I asked a workman the other day whether he thought that most of

* 'Transactions,' Vol. I, p. 177.

them were alive. His reply set the matter satisfactorily at rest —“If you please, sir, they’ve all got ‘hoysters’ in them.” I have never ventured to taste the oysters referred to.

It will be noticed by those who are conversant with the fish of other rivers that I have been compelled to omit two rather important species from the catalogue I have just given.

The grayling, supposing that he possesses an ordinary sense of propriety, ought surely to delight in frequenting the higher reaches of the Gade. Along the charming valley, through which it flows, the population is extremely limited, no drainage can pollute the purity of the stream, it is carefully protected from the ravages of the poacher, its current is sufficiently rapid to satisfy the most fastidious of fish, and its clean gravelly bottom is not unfrequently noticeable. Notwithstanding the force of all these attractions, I have never heard of grayling being taken either in the Bulborne or Gade. I wish that it were possible to introduce them into these waters, and I am inclined to think that the experiment, if properly and carefully made, might be found to be successful.

The other species I have to refer to, is the barbel. This fish is abundant in the Thames, where it grows to a great size; but it loves to frequent deep holes along the banks of large rivers, and it need not surprise any one that it declines to patronise our shallow sparkling Gade.

The art and practice of pisciculture has been ably treated by our President, and I willingly leave the subject in his hands; but I think that there are other phases connected with the Natural History of fishes which have not as yet been brought before our notice. I hope that some of these may claim the attention of our members, and that on a future occasion they may be explained and illustrated in this room by an abler pen than mine.

The scales of our fresh-water fishes, differing as they do so widely in form, in colour, and in texture, and affording distinct characteristics of each individual species, are objects of infinite interest, and I especially commend them to the notice of our numerous microscopists. The periodical migration of fishes, their varying colour, and the manner in which they assimilate to the prevailing tint that surrounds them, are also subjects that would well repay our careful consideration and study.

It has been commonly asserted that fish, of all living creatures, are the most devoid of instinct. I do not, for one moment, believe that they can compete in instinct with either birds or mammals, but I hope that I have been able to adduce on their behalf a few instances of undeniable intelligence. I must remind my hearers that the fish exists in a medium altogether foreign to ourselves, and it is extremely probable that we may fail, on this account, fully to appreciate the finer susceptibilities of its nature.

When first I determined to collect the necessary information for the paper I have now read to you, I little thought how strongly I should be led onward by an almost resistless continuity of interest

to the consideration of kindred subjects, all intimately connected with it; and it seems to me that it is this most fascinating influence which supplies to the study of Natural History its peculiar charm. It is impossible to follow the windings of even a well-known valley, or to explore the source of the little rivulet that so much contributes to its beauty, without meeting at almost every step new objects of interest as unlooked for as they are altogether welcome. Again and again has the flora of the two streams invited a more intimate acquaintance and tempted me to re-open the pages of sundry botanical volumes, unfortunately neglected for a quarter of a century. One treads on a piece of conglomerate that juts a little into the current, in order, probably enough, the better to observe the graceful movements of a bonny trout, and, before one can retrace the step, affrighted crayfish crawl out from beneath its shelter, and a shoal of tiny minnows swim rapidly away. There, too, attached with marvellous ingenuity to the sides of an old oaken post which in days long gone by may have assisted in supporting the bank, is the caddis-worm. Insects glide along over the surface, water-beetles send away right and left, and the little river, which flows so silently before us, is found to be absolutely replete with animal life. But beyond these, and more wonderful than all, the sparkling waters of the Bulborne and the Gade, in common with every stream that flows, are peopled by countless myriads of living organisms, each supplying to the Entomologist an object of unbounded interest. The very fish that I have attempted to describe, subsist, for the most part, on animalculæ so small that one can distinguish them only by the aid of the microscope; and yet we may, I think, confidently believe that not one amongst them all remains unheeded or uncared for by the Almighty Power that fashioned it, or fails to perform its individual purpose in the plan of Nature.

“ My heart is awed within me when I think
Of the great miracle that still goes on
In silence round me;—the perpetual
Work of thy creation, finished, yet renewed
For ever.”

19.—THE ORIGIN AND PRESENT DISTRIBUTION OF THE BRITISH FLORA.

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ALTHOUGH climate is the most essential element to be taken into account when the distribution of the plants of any flora is to be considered, yet as that of our own country at the present time is so well known, it will be superfluous to describe it in detail.* All that will be necessary is to compare it, or rather contrast it generally, as being insular and maritime, with that of the Continent; and then to see what differences may be expected to exist between the flora of Great Britain and that of Europe.

The chief difference between all maritime or insular and continental climates lies in the predominance of moisture† in the air of the former and in the greater degree of dryness in that of the latter. The immediate effect of watery vapour is to moderate the heat in summer by arresting its passage from the sun, and similarly to arrest its radiation at night and in winter. The consequence is that maritime and insular climates are far less subject to extremes of temperature, diurnal or annual, than are places situate away from a sea-board and many miles in the interior of a continent. Another very important agent in affecting the climate is the prevalence of aerial and ocean currents; warm in ameliorating, cold in deteriorating it, as far as the magnitude and vitality of any flora may be concerned. This is particularly the case with the British Isles; for, were it not for the warm currents both of air and water sweeping past us in a north-easterly direction across the Atlantic, our climate would be very likely to be as inhospitable as is that on the same latitudes in America.

Perhaps few places could be better chosen to illustrate the above statements than Edinburgh and Moscow. Thus, while the difference between the hottest and coldest months of the year is under 30° for Edinburgh, it amounts to 60° for Moscow; and, it may be

* The word *climate* must be taken to represent the aggregate environment of plants included under:—1. Latitude; 2. Elevation above the sea; 3. Maritime or insular or continental position; 4. Inclination of land; 5. Mountainous country or otherwise; 6. Character of soil; 7. Condition of soil, wet or dry, etc.; 8. Degree of cultivation; 9. Prevalent winds; 10. Rainfall; 11. Mean summer and mean winter temperatures, etc.

† As an illustration of the effect of moisture upon the distribution of plants, may be mentioned the fact that tropical forms extend into subtropical regions, if damp; as in South America: *e.g.*, tree-ferns, epiphytal orchids, *Myrtaceæ*, etc. Similarly the laurel, fig, and bamboo ascend the humid extra-tropical mountains of Bengal and Sikkim to 9000 feet; while on the other hand, a temperate flora, consisting of *Quercus*, *Salix*, *Rosa*, *Prunus*, *Rubus*, *Camellia*, *Pinus*, etc., descends to the sea in lat. 25° in India.—*J. D. Hooker*.

added, for Nain, on the coast of Labrador, it is 50° , and for Cape Churchill, on the west coast of Hudson's Bay, the difference is even 80° . All the above places are very nearly on the same parallel of latitude. Again, if we take winter and summer temperatures, we find that for July the mean at London is over 62° ; at Berlin, 66° ; at St. Petersburg, 64° ; and at Astrakhan, 77° . While for January at London it is 37° ; at Berlin, 28° ; at St. Petersburg, 16° ; and at Astrakhan it is 13° . Similarly in Cumberland (North America), in the latitude of Edinburgh, the winter temperature is -13° , the summer temperature being $+62^{\circ}$.

If we consider the temperature of places in the west of Europe, we soon see how important is the influence of warm aerial currents in regulating and ameliorating them; thus, at Hammerfest (lat. 71°), in Norway, the mean winter temperature is 22° , while in the same latitude in Greenland it is 5 degrees below zero. Again, the temperature at

Caithness	58 deg. N.L. is	36 deg. in January
Labrador	" "	" — 4 "
Lisbon	39 " "	47 " "
Chesapeake Bay	" " "	—36 " "
And the temperature at		
Edinburgh	56 deg. N.L. is	37 deg. in January
Bergen (Norway)	60 " "	32 " "
Jakutsk	62 " "	—36 " "

In the latter group of places we see the great contrast between the temperature of an inland site, such as Jakutsk, and that of the maritime coast of the west of Europe, which is swept by warm currents.

Now, the most obvious effect that such differences of temperature have on plants is that a continental climate is favourable to annuals and a maritime to perennials; for in places where a summer temperature rises high, plants, whose whole life-history is comprised in a few months or even weeks, may easily, therefore, survive; while the intensely cold winters of the same place would annihilate many perennials that would flourish in a less rigorous climate. Hence evergreen shrubs of South Europe, such as the laurustinus and bay laurel, will survive our winters, which are rarely excessive, yet the climate in summer and autumn is quite insufficient in its degree of heat to ripen efficiently the grape or Indian corn; for the summers are as equally tempered as the winters.

The British flora, as might, therefore, be expected, contains a large amount of perennials, especially, perhaps, herbaceous ones. Many annuals, being weeds of cultivation only, would be probably more or less exterminated if our arable land should cease to be cultivated.

In reviewing our flora as a whole, in some respects it may be regarded as insular in character, though in others it is continental; that is to say, there is no plant which is peculiar to it, and with rare exceptions every member of it belongs to the neighbouring Continent of Europe. As, however, we are at present insular, it

will be as well to consider what are the characters of an insular flora, and then see how far they agree with that of Great Britain and Ireland. Sir Joseph Hooker, in his lecture on "Insular Floras" (reprinted in the 'Gardeners' Chronicle,' Jan. 1867), tells us that the relationships between *oceanic* island floras are of two kinds, as follows:—

I. A relationship of analogy between themselves, due to physical conditions common to all. These may be enumerated as follows:—

1. They are rich in ferns, mosses, and other flowerless plants.
2. They have many evergreens.
3. They have few herbaceous plants.
4. They have very few or no indigenous annuals.
5. Species which are herbs on the Continent become shrubby on the islands.
6. The species are few in proportion to genera, and genera few in proportion to orders.
7. The total number of species is small when compared with that of a continental area of equal size and of similar conditions.
8. The mountains, however lofty, have few alpine or subalpine species.

II. A relationship of *bonâ fide* kinship which the floras of oceanic islands display; (1) in common with one another; (2) with certain continents or parts of them.

The above conditions apply to oceanic islands, mostly being tropical and subtropical, and can, therefore, hardly be expected to be equally applicable to our own, which have undoubtedly formed part of the Continent at a recent geological period. Consequently the above peculiarities will be found to have but a limited application.* It is not until we apply the sixth peculiarity that we see any very strong resemblance, namely, in the proportion of genera to species. Thus, testing it by the Ranunculaceæ, this order has 30 genera and 550 species, while the British Isles have 14 genera and only 40 species; so that, avoiding fractions, we may say that while our flora has 50 per cent. of the genera, it has less than 8 per cent. of the species. Similarly with regard to the order Umbelliferae, which contains 150 genera and 1300 species, the British Isles possess 38 genera and 65 species; that is to say, about 25 per cent. of the genera, and only 5 per cent. of the species.† With regard to the relationship of affinity, there are

* With regard to the third peculiarity, it may be noted that we possess 94 shrubs and trees (considering *Rubus*, *Rosa*, and *Salix* as including twenty-nine species in all), and recognising our flora at about 1600 species, the proportion will be nearly 6 per cent. Taking trees alone as about fifty of the above, they give for themselves a proportion of about 3 per cent. of the whole flora. In New Zealand, flowering trees alone form one-sixth of the flora, or more than 16 per cent.

† As an illustration of No. 6. In New Zealand "the number of natural orders is large in proportion to genera; being as 92 to 282, or about 1 to 3; while the genera are to species as 282 to 730, each genus having on the average only $2\frac{1}{2}$ species; whence it follows that there are, on the average, but 8 species

no forms peculiar to Great Britain whatever; with one or two exceptions (e.g. *Eriocaulon septangulare*), every plant may be found on the Continent.

Although our British plants are almost all European, yet they are not equally or at all uniformly distributed over our territory. They have, consequently, been divided into sub-floras or *florulæ*, each being more or less restrictive in area. We are indebted mainly to the labours of the late Professor Edward Forbes and Mr. H. C. Watson for tracing out these districts. The following is a comparative table of the respective results of these eminent botanists, with their nomenclatures:—

WATSON'S.		FORBES'.
1. British corresponds with	}	Germanic.
2. English		
3. Scottish		
4. Highland		
5. Germanic (in part)	{	Alpine.
6. Atlantic		Kentish.
7. Local or doubtful.		Asturian.
		Armorican.

That entitled *Germanic* by Forbes is so called because it is identical with the German flora, though the latter contains many plants wanting in England. This is subdivided by Watson into (1) the *British*, which includes plants found in all his eighteen "provinces"; (2) the *English*, which includes plants found chiefly in England and not in Scotland; and (3) the *Scottish*, embracing plants found chiefly in Scotland and the North of England only. The *Alpine* of Forbes or the *Highland* of Watson includes a group of arctic plants found on the Scandinavian mountains and on alpine localities, but not in the intermediate temperate lowlands. Watson's *Germanic* takes in plants found in the east and south-east of England bordering the German Ocean, from whence he derives the name, and includes those plants called *Kentish* by Forbes, but which do not seem to be deserving of a special name, as they are chiefly, if not always, plants affecting a limestone or chalky soil, and which, in part, occur elsewhere. The *Atlantic* types of Watson embrace plants found in the west and south-west of England and in Ireland. In these are included the *Armorican* of Forbes, which is characterised by a group of plants found in Normandy, the Channel Islands, the south-west of England, extending (in part) some distance along the west coast, and in the south-east of Ireland. The number of peculiar species continually decreases in passing in a north-westerly direction from their original home in Normandy; so that while several which are in the Channel Islands are wanting in the south-west of England, others which reach that corner

to each natural order; whereas in Great Britain the average is 14 species to one natural order. It may be added that the probable proportion of species of plants on the globe to the known number of natural orders exceeds 350 to 1."—Hooker, 'Introductory Essay to the Flora of New Zealand,' p. xxviii (1853).

fail to cross over to Ireland.* A portion of this Atlantic type was separated by Forbes as *Asturian*, because the nearest locality on the Continent whence it was presumed by him that these plants had come was the Asturian mountains of North Spain. They consist of six species of saxifrage:—*Saxifraga umbrosa*, *S. elegans*, *S. hirsuta*, *S. Geum*, *S. hirta*, *S. affinis*; two heaths:—*Erica Mackaiana*, *E. mediterranea*; *Menziesia polifolia*; *Arbutus Unedo* (the “strawberry tree”); and *Arabis ciliata*.†

Such is an epitome of our present flora with regard to its distribution within our own islands. The next thing is to consider its extension throughout the world. We have already seen that the great bulk of our plants included in Watson’s British and English types (containing about three-fifths of the whole flora) is identical with the flora of Germany; hence Forbes’ name of *Germanic*; while the *Atlantic* type of Watson corresponds more especially with the Norman flora and that of the Channel Islands; and if we take note of Forbes’ *Asturian*, we find that small and fragmentary sub-flora on the Asturian Mountains of Spain. There remains, then, the *Highland*, *Alpine*, or *Arctic* type. The nearest localities where plants of this group are to be found are the Alps, Pyrenees, Scandinavian mountains, and arctic regions generally; though they are

* *Helianthemum polifolium*, *Tamarix Gallica*, *Polycarpon tetraphyllum*, *Corrigiola littoralis*, and *Bupleurum aristatum* occur in Devonshire and Cornwall, but do not extend into Ireland. The following are some which are to be found in the Channel Islands, but not in England or Ireland:—*Ranunculus ophioglossifolius*, *Sinapis incana*, *Helianthemum guttatum*, *Silene quinque-vulnera*, *Centaurea aspera*, *Gnaphaleum luteo-album*, *Cicendia pusilla*, *Linaria Pelis-seriana*, *Echium plantagineum*, *Armeria plantaginea*, *Orchis laxiflora*, *Scirpus pungens*, *Lagurus ovatus*, *Cynosurus cristatus*, *Bromus maximus*, *Gymnogramme leptophylla*, *Ophioglossum lusitanicum*.

† Subjoined are a few selected plants in order to illustrate the subfloras of Watson:—

1. British type. *Betula alba*, *Corylus Avellana*, *Salix Capræa*, *Rosa canina*, *Hedera Helix*, *Calluna vulgaris*, *Ranunculus acris*, *Trifolium repens*, *Lotus corniculatus*, *Bellis perennis*, *Myosurus minimus*, *Urtica dioica*, *Lemna minor*, *Poa annua*, *Pteris aquilina*, *Polygonum aviculare*.

2. English type. *Rhamnus catharticus*, *Ulex nana*, *Tamus communis*, *Bryonia dioica*, *Hottonia palustris*, *Chlora perfoliata*, *Sison amomum*, *Linaria Elatine*, *Ranunculus parviflorus*, *Lamium Galeobdolon*, *Hordeum pratense*, *Ceterach officinarum*.

3. Scottish type. *Empetrum nigrum*, *Rubus saxatilis*, *Trollius europæus*, *Geranium sylvaticum*, *Habenaria albida*, *Ligusticum scoticum*, *Lithospermum maritimum*.

4. Highland type. *Azalea procumbens*, *Cherleria sedoides*, *Veronica alpina*, *Alopecurus alpinus*, *Phleum alpinum*, *Juncus trifidus*, *Sibbaldia procumbens*, *Erigeron alpinus*, *Gentiana nivalis*, *Salix herbacea*, *Silene acaulis*, *Saxifraga stellaris*, *Oxyria reniformis*, *Thalictrum alpinum*, *Rubus Chamæmoros*, *Epilobium alsinifolium*, *Dryas octopetala*, *Alchemilla alpina*.

5. Germanic type. *Frankenia lævis*, *Anemone Pulsatilla*, *Reseda lutea*, *Silene noctiflora*, *Silene conica*, *Pimpinella magna*, *Pulicaria vulgaris*, *Atriplex pedunculata*, *Aceras anthropophora*, *Ophrys aranifera*, *Spartina stricta*.

6. Atlantic type. *Sinapis monensis*, *Matthiola sinuata*, *Raphanus maritimus*, *Sedum anglicum*, *Cotyledon umbilicus*, *Bartsia viscosa*, *Euphorbia Peplis*, *E. Portlandica*, *Sibthorpia europæa*, *Erica vagans*, *E. ciliaris*, *Polycarpon tetraphyllum*, *Adiantum Capillus-Veneris*, *Cynodon Dactylon*.

mostly or entirely absent from the warmer lowlands which separate such widely-severed districts.

If, however, we now leave Europe, and endeavour to find any British plants elsewhere, we shall discover small groups of this last type appearing here and there in many parts of the world. The following numbers will indicate how many British plants have been hitherto found in the several localities, and will also illustrate the fact that the plants of Britain, like Her Majesty's dominions and subjects, are world-wide in their dispersion. Travelling eastwards from the Ural Mountains, Siberia contains about 750 British plants, and within the area included between the River Obi and Behring's Straits, and bounded southwards by the Arctic Circle (lat. $66\frac{1}{2}^{\circ}$), there are 111. Kamskatka contains 140. In North-east Asia, including the area from Behring's Straits to South Japan, there are 325, of which Japan has 156 British species.

Next, regarding the extension of our plants eastwards along the southern line of mountains, Hooker and Thomson give a list of 222 British plants which reach India.* These appear to have travelled eastwards from Europe, finding means of transit along the Taurus, Caucasus, and western hilly or mountainous regions; and the above authors remark that "the keystone to the whole system of distribution in Western Asia does not rest so much upon a number of 'representative' species as upon the fact that not only are a large proportion of annual and herbaceous species of each common to Western India and Europe, but of shrubs and trees also. Those of North Europe inhabit the loftier levels of the Himalayas, where they blend with the Siberian types." The following British trees and shrubs occur in India:—*Berberis vulgaris*, *Prunus Padus*, *P. Avium*, *Rubus fruticosus*, *R. saxatilis*, *Crategus Oxyacantha*, *Cotoneaster vulgaris*, *Pyrus Aria*, *Ribes Grossularia*, *R. nigrum*, *Hedera Helix*, *Buxus sempervirens*, *Ulmus campestris*, *Salix purpurea*, *S. alba*, *Taxus baccata*, and *Juniperus communis*. It may be added that European types disappear eastwards gradually at first, but rapidly after reaching Kumaon. Few species enter Nepal, and still fewer reach Sikkhim. Of the plants which cross the Indian mountains and appear in Tropical Asia (*i.e.* India south of the Himalayas, the Khasia mountains of Eastern Bengal, together with the mountains of both peninsulas of India, Ceylon, and Java), the number, as might be expected, is much reduced, only 23 species being found there.

The next distributions to be considered are along the three greatest lines of extension of land into the southern hemisphere—namely, first, from India, through the East India Islands to Australia, Tasmania, New Zealand, and the islands to the south; secondly, from Europe, through Africa and the islands near the coast to the Cape; thirdly, from Greenland and Arctic America to Cape Horn; lastly, the isolated spots in Polynesia, which can boast of a few representatives of the British flora.

* 'Flora Indica,' p. 109 (1855).

I. Of the first of these extensions South Australia contains 100 indigenous plants common to Great Britain, in addition to which a large number have become naturalised; Tasmania contains 56, New Zealand has 92, and Kerguelen's Land, 8; while Auckland and Campbell Islands possess 6. A curious fact worth notice is that in South-eastern Australia, European species form $\frac{1}{27}$ th nearly of the whole flora; but in South-western Australia they constitute $\frac{1}{100}$ th only; while in Tasmania they amount to $\frac{1}{15}$ th. In Tasmania the following British plants occur, which are not found in Australia:—*Ranunculus aquatilis*, *Montia fontana*, *Hierochloe borealis*. On the other hand, the Victoria Alps of Australia contain fifteen European species not found in Tasmania, and all but one are British plants.

II. With regard to the extension of British plants from Europe to the Cape, commencing with Morocco we find 344 present there, while in northern Africa generally, which is largely "Mediterranean" in character, there are 420 British plants. North-east Africa and Abyssinia appear to yield about 90 British species. On the west coast of Africa, the little island of Fernando Po in the Gulf of Guinea was found to contain, on "Clarence Peak," at above 5000 feet elevation, 76 species of plants, of which number 56 species of 45 genera belong to a temperate flora. Their affinity is curiously much more with the plants of Abyssinia and of the Mauritius than with those of the adjacent west coast of Africa! Of the temperate flora a large proportion are European, and the following seven are British:—*Oxalis corniculata*, *Sanicula europæa*, *Galium Aparine*, *Limosella aquatica*, *Luzula campestris*, *Aira cæspitosa*, *Brachypodium sylvaticum*. Of the South African flora, including the portion of land from the Tropic of Capricorn to the Cape, 27 species are British.

III. In the third great extension of land, Greenland contains 210 (Iceland has 335), while British plants abound in arctic British America, as in Siberia, even Parry's Island (76° North latitude) containing 32. The number decreases as the warmer regions are reached; thus Mr. Drummond* records only 40 British plants in the Western States. In tropical America (including the temperate and alpine regions of the Cordillera from Mexico to Peru) there are 35 British plants, of which the following eight are common with tropical Asia:—*Cardamine hirsuta*, *Stellaria nemorum*, *S. media*, *Ceratophyllum demersum*, *Polygonum Persicaria*, *Juncus bufonius*, *Scirpus lacustris*, *Phragmites communis*. In extra-tropical South America, however, there are no less than 64 British species, while in Fuegia and the Falkland Islands there are 24. Of the British plants common to these three greatest extensions of land there are common to Australia, etc., and Africa, 17; common to Australia and South America, 35; common to South Africa and South America, 19; common to all three extensions, 15. Lastly there have been found a few British plants in islands

of the Pacific Ocean. Thus, the Society Islands contain 3; the Sandwich, 5; and Fiji, 16 species.

If now we attempt to find an explanation to the fact of so many plants thoroughly establishing themselves in foreign countries, there are two features which strike us as worthy of observance. One peculiarity is that plants do not always flourish best where Nature has, so to say, made their home, but in consequence of the struggle for existence they hold their position as long as other plants will let them grow, so that the flora of any locality under normal and existing circumstances has, so to say, long ago arrived at a condition of equilibrium of mutual adjustment. If, however, plants be suddenly transported to other countries, they sometimes at once assume astonishing vigour, and for a long time at least gain great ascendancy over the native vegetable population. This was conspicuously so in New Zealand, where the English water-cress grows to twelve feet in length, and three-quarters of an inch in thickness; while a single plant of *Polygonum aviculare* will cover several square feet, and the little Dutch clover is driving the huge *Phormium tenax* or "New Zealand flax" before it! Similarly does the Canadian *Anacharis Alsinastrum* flourish in England, though we possess the female plant only. It would seem, therefore, that the change of climate has somehow introduced new and invigorating elements into their constitution, which the native flora cannot acquire, having been so long adapted to it. This appears to be one cause of introduced plants so readily establishing themselves. Another is that these sporadic plants, being generally inconspicuous annuals and *self-fertilising*, are independent of insects; so that they survive in the struggle for existence over their more showy brethren, which cannot propagate fully by seed unless habitually visited.

In a previous paper on the "Fertilisation of Plants,"* I have shown how this was the case as deduced from statistics, and so will not repeat the evidence now; but would just illustrate it by mentioning a few of the most widely dispersed of our British plants. *Cardamine hirsuta* is found in north-east Asia, tropical Asia, Hong-Kong, Kamskatka, Chili, South Australia, Auckland and Campbell's Islands, Falkland and Fuegia, Tasmania, South Africa, New Zealand, Madeira, etc. Similarly is *Cerastium vulgatum* dispersed over the same area. *Solanum nigrum* is also found in California, South Australia, Tasmania, New Zealand, Society Islands, Andaman Isles, North China, Japan, Galapagos Islands, etc.

I will conclude this portion of the subject with a summary of the general phenomena of botanical distribution, condensed from Hooker's 'Flora of Tasmania.'

1. Species have a definite or circumscribed area, or "specific centres;" varieties being more restricted than species, and species than genera. Cause of this:—"Plants grow where other plants will let them."

*'Trans. Watford Nat. Hist. Soc.,' Vol. I, p. 201.

2. The three "Classes" are generally distributed, and the larger "Orders" also.

3. The least complex are most widely diffused.

4. "Representative" forms occur under similar but separated conditions.

5. Every country has a different flora.

6. Exuberance decreases from the Equator to the Poles.

7. Uniformity in numbers and luxuriance mark some countries; great variability, others.

8. The Arctic (Scandinavian) flora is the only one found on temperate and tropical mountains as well as in the extra-tropical southern hemisphere.

9. Insular floras (Oceanic) are peculiar.

10. Naturalised plants increase in proportion as they are trees, shrubs, perennials, or annuals.

11. The causes of distribution are changes of climate, as also of land and sea.

Having now considered the present distribution of the British Flora, we have to account for it as far as possible; and here theory must supplement facts. In looking back to discover a historical or rather geological origin of our present flora, we soon find that there have been very remarkable changes in the characters of successive floras that peopled our country. Going no further back than the Eocene period—for attempts at deductions as to climatal conditions become more and more uncertain in proportion as the faunæ and floræ are more remote in time from and unlike their living representatives—we find tolerably certain evidence that the climate of England at that time was tropical, at least so far as palms, *Mimosæ*, *Nipadites*, on the one hand, and turtles, crocodiles, and large water snakes on the other, justify us in drawing such a conclusion. This period, then, could not have seen the origin of our present temperate and arctic floras. The next epoch, the Miocene, likewise fails to furnish any members of it. The flora of this period was subtropical, but probably became less and less so as the next—the Pliocene epoch—drew near. The Miocene flora is remarkable for its great extent. Not only are remains of plants to be found in England, as at Bovey Tracey in Devonshire, but at many places on the Continent; and what is still more remarkable, it is found to have extended all over the Arctic regions—as at Disco Island, Greenland, arctic North America, etc. In all these places such plants as vines, custard apples, figs, cinnamons, *Nelumbium* (the lotus of the East), water-lilies, and the ubiquitous "*Wellingtonia*"* are to be found. This shows, therefore, that there must have been a very different state of things in the Northern hemisphere then from what obtains now. The preceding flora had its day, flourished, and then passed away for ever. A colder period drew on. This

* This genus is better known to botanists as *Sequoia*, and the species *S. Coultsiæ* is found at Bovey Tracey; two species only now exist, *S. sempervirens* (red-wood) and *S. gigantea*, both confined to California.

is signalised in our country by the celebrated Cromer Forest, and the peat or lignite beds on the north coast of Norfolk.* These are overlaid by a steep cliff of "glacial deposits." The flora of these beds is identical with the existing one; that is to say, the Scotch fir, accompanied by the Norway spruce (now extinct, but re-introduced), both our water-lilies, the buck-bean, alder, etc., then flourished, but with the strange companions of *Elephas meridionalis*, many *Cervi*, the *Rhinoceros*, the great *Bos primigenius*, the Irish elk, and other extinct animals.

The reduction of temperature (for the forest-beds indicate as temperate a climate as our own), seen by comparing it with that of the preceding Miocene period, was the antecedent condition to an arctic or glacial state of things shortly to follow, or "the Great Ice Age." The evidence of this, as derived from plants, is seen in the presence of an arctic willow, *Salix polaris*, found in a deposit overlying the subtropical Miocene beds at Bovey Tracey.

Now, as England is at present temperate, and an arctic flora reigns over high latitudes simultaneously with it, so does it seem probable that such was the state of things, if not before, at least soon after the close of the Glacial Epoch; that when the Cromer Forest flourished, an arctic flora prevailed simultaneously with it in high latitudes. As, however, the ice continued to increase southwards, and the land in all latitudes was encroached upon and rendered unfit for such plants to inhabit, they were driven southwards down every meridian, from the arctic regions. The long line of mountains in America, forming an unbroken bridge of transport, enabled many to cross the tropics and so reach the extra-tropical regions of South America. Mr. Belt discovered signs of "glaciation" in Nicaragua down to 2000 feet above the sea, apparently showing that there was a "cooling" going on at least locally in the tropical regions, which would seem to dispose of the difficulty of arctic plants crossing the torrid zone. Similarly in the eastern hemisphere, assuming the land to have been continuous, and there are solid reasons for believing it to have been so, the arctic flora would have been able to find a passage from the Himalayas, through eastern China and the Celebes, to Australia, New Zealand, and Tasmania.

Another suggestion is that the Australian forms came from South America to New Zealand, then Tasmania, and finally Australia; for the New Zealand flora is strangely like that of South America in some respects, and it has been shown above that Tasmania has more British types than Australia.†

* Whether the temperate period indicated by these plant-beds preceded the "Glacial" epoch, or represent interglacial milder periods, is perhaps at present undecided by geologists.

† Hooker thus sums up his observations on this dispersion, in his Introductory Essay to the 'Flora of Tasmania,' p. ciii:—"When I take a comprehensive view of the vegetation of the Old World, I am struck with the appearance it presents of there being a current of vegetation (if I may so fancifully express myself) from Scandinavia to Tasmania; along, in short, the whole extent of that

Thus is it supposed that the arctic flora has been driven over all the world, and on the close of the Glacial Epoch the plants situated on what are now tropical plains perished, or else retired up the mountains where we now find them, as on Clarence Peak in the island of Fernando Po; while in the northern hemisphere many retreated back again into arctic regions perhaps accompanied by other plants of the countries they had previously invaded.

With reference to our own islands, there is reason to believe that the Atlantic type of Watson, or the groups including the *Asturian* and *Norman* or *Armorican* of Forbes, are very ancient. This is inferred, first, from their fragmentary character; secondly, from their isolation; and thirdly, from the fact that boulders have been found stranded on the south coast of England, implying that these islands were severed from the Continent, at least on the west and south-west, during the Glacial Epoch, and that, therefore, these plants owe their origin to a much earlier connexion with the Continent; for, as already remarked, the nearest continental site of the Asturian plants is to be found in Spain; while the Armorican doubtless came from Normandy. With regard to the Arctic and common English and Scottish types, many of which are to be found in the Arctic regions, they appear to have travelled from the north, or from the Scandinavian regions across the plain of the German Ocean;* but on the subsequent depression of the land below the sea, and with the elevation of temperature to its present state, the more arctic types would be confined to the tops of our mountains, while the rest would people the plains, and the floras would thus be gradually established in our islands in the conditions in which we now find them.

are of the terrestrial sphere, which presents the greatest continuity of land. In the first place, Scandinavian genera, and even species, reappear everywhere from Lapland and Iceland to the tops of the Tasmanian Alps, in rapidly diminishing numbers, it is true, but in vigorous development throughout. They abound on the Alps and Pyrenees, pass on to the Caucasus and Himalaya, thence they extend along the Khasia Mountains, and those of the peninsulas of India to those of Ceylon and the Malayan Archipelago (Java and Borneo), and after a hiatus of 30⁵, they reappear on the Alps of New South Wales, Victoria and Tasmania, and beyond. Then, again, on those of New Zealand and the Antarctic Islands, many of the species remaining unchanged throughout. It matters not what the vegetation of the bases and flanks of the mountains may be; the northern species may be associated with Alpine forms of Germanic, Siberian, Oriental, Chinese, American, Malayan, and finally Australian Antarctic types; but whereas these are all more or less local assemblages, the Scandinavian asserts his prerogative of ubiquity from Great Britain to the Antipodes."

* There appear to have been four well-marked periods at least in the Glacial Epoch: (1) a period of elevation at the time of Cromer Forest; (2) one of great depression, so that Great Britain became an archipelago; then (3) a re-elevation, when the German Ocean was land; and finally a last depression to its present condition.

20.—NOTES ON THE BOTANY OF THE EXPERIMENTAL GRASS PLOTS AT ROTHAMSTED, HERTFORDSHIRE.

By JOHN J. WILLIS.

Communicated by J. Hopkinson, Hon. Sec.

[Read 12th December, 1878.]

AMONG the numerous experiments conducted at Rothamsted by Messrs. Lawes and Gilbert, there are none more interesting, certainly not to the botanist, than those made on permanent meadow land, because, independently of their value in practical agriculture, they afford great facilities for the study of botany in all its various branches. Our meadow lands comprise, as is well known to botanists, not only a great number of genera and species belonging to the grass family—the natural order Graminaceæ—but also various members of other families of plants.

In the year 1856 Mr. Lawes set apart about eight acres of grass land in his park at Rothamsted, for the purpose of investigating the comparative effects of different manuring substances upon permanent grass; in the first instance probably to determine the best means of increasing the gross amount of produce. But not only has the general character of the herbage as to vigour, colour, date of ripening, etc., materially altered, but the composition of the produce has been entirely changed under this treatment. The portion of land selected by Mr. Lawes for these experiments is composed of a heavy loam, with a red clay subsoil of several feet in depth immediately overlying the Chalk; and it has probably been laid down with grass for some centuries. No fresh seed has been artificially sown within the last fifty years certainly, nor is there a record of any having been sown since the grass was first laid down. As previously stated, the experiments commenced in the year 1856, at which time the character of the herbage appeared uniform over all the plots. The portion of ground was divided into twenty plots of from a quarter to half an acre each, and in most cases the same description of manure has been applied year after year to the same space of ground, two pieces being left as test plots and entirely unmanured; and the results, which have been fully and carefully noted, are very extraordinary.

Besides weighing the produce obtained by the different manures as hay, and taking samples for the determination of its chemical composition—namely, dry matter, ash, nitrogen, woody fibre, fatty matter, etc.—carefully averaged samples are taken in each fifth year from all the plots, and every year from selected plots, and submitted to careful botanical separation, the per-centages by weight of each species in the mixed herbage being determined. This is necessarily a most tedious and lengthy proceeding, occupying a period of several months in the laboratory, and requiring considerable skill at the identifications—a labour which appears to present

insurmountable difficulties, but with a little practice is easily accomplished. Sharp lads of about fourteen years of age soon learn (of course, under special training) to distinguish most of the species, even to the smallest fragments of the leaves of any of the grasses. The characters of the leaves of the plants are various, and are found in their texture, surface, colour, point, ligule, mode of curling or folding together when dry, nature of the margin, hairiness, relative prominence of the midrib, etc. By one or more of these characters it is possible to distinguish almost any piece, however small.

In the Laboratory at Harpenden is to be seen by the visitor a large upright wall-case, which shows the botanical composition of the herbage on seven selected plots in the twelfth year of the experiments (1867); and at the South Kensington Museum is one contributed by Mr. Lawes, showing the composition in twelve selected plots in the seventeenth year (1872). The quantities of the different plants there exhibited represent the relative proportion by weight in which each species was found; and the whole illustrates in a striking manner the domination of one plant over another, under the influence of the different manures applied.

The general results of the experiments may be briefly summarised as follows:—

The mean produce of hay per acre, per annum, has ranged on the different plots from about 21 cwt. without manure, to about 63 cwt. on the plot most heavily manured.

The number of species found has generally been about 50 on the unmanured plot, where there is no marked predominance of one plant over another; and has been reduced to an average of only 20 on the plot most heavily manured, where the effect is to stimulate some of the coarser growing grasses, and other plants, to extraordinary growth, and crowd out or otherwise cause to disappear the more weakly species; and it may be stated as a rule that whatever the description of manure employed, any considerable increase of crop is accompanied by greater simplicity of herbage.

Species belonging to the order Graminaceæ have on the average contributed about 68 per cent. of the weight of the mixed herbage grown without manure, about 65 per cent. of that grown with purely mineral manure (consisting of salts of potash, soda, magnesia, and super-phosphate of lime), and about 94 per cent. of that produced with the same mineral manure with a large quantity of ammonia-salts in addition.

Species of the order Leguminosæ have, on the average, contributed about 9 per cent. of the produce without manure, about 20 per cent. of that with purely mineral manure, and less than 0·01 per cent. of that with the mixture of the same minerals and a large quantity of ammonia-salts.

Species belonging to various other orders have, on the average, contributed about 23 per cent. of the produce without manure, about 15 per cent. of that with mineral manure, and only about 6 per cent. of that with the mixture of minerals and ammonia-salts.

The struggle for existence which is going on between plant and plant may be illustrated by a comparison of the per-centages of a few grasses on the unmanured and the most highly manured plots.

	Unmanured.	Highly Manured.
<i>Alopecurus pratensis</i>	0·52 per cent.	12·35
<i>Anthoxanthum odoratum</i>	5·20 „ „	0·78
<i>Avena flavescens</i>	3·49 „ „	0·09
„ <i>pubescens</i>	3·55 „ „	0·00
<i>Briza media</i>	6·40 „ „	0·00
<i>Cynosurus cristatus</i>	1·11 „ „	0·00
<i>Dactylis glomerata</i>	0·90 „ „	39·28
<i>Festuca ovina</i>	21·67 „ „	0·38
„ <i>pratensis</i>	0·13 „ „	10·41
<i>Poa pratensis</i>	0·09 „ „	10·40

The complete Flora of the experimental plots may be summarised as follows :—

Total number of species	93
„ „ genera	67
„ „ orders	23
Number of species of Acotyledons.....	15
„ „ Monocotyledons	24
„ „ Dicotyledons	54

Amongst these are several species not commonly met with on meadow land,—such, for instance, as *Ranunculus auricomus*, *Vicia Cracca*, *Vicia sepium*, *Galium Aparine*, *Sonchus oleraceus*, *Fritillaria meleagris*, *Trifolium procumbens*, and *Ornithogalum umbellatum*. But these are only represented by a few individuals, and form no appreciable proportion of the crop. Amongst the acotyledons are included eleven species of Fungi found on the various plots. One fern, *Ophioglossum vulgatum*, and three species of mosses, *Hypnum squarrosum*, *H. rutabulum*, and *H. hians*, are also met with.

In the many points of interest brought out in these investigations it is found that even plants of the same genera differ so materially in their character and habit of growth, that, when in association with each other and with other plants, and subject to a great variety of conditions as to manure, they comport themselves in the struggle very differently. In order to gain further information respecting this subject, samples of the soil from all the experimental plots have been taken, to a depth of five feet, and the roots have been separated and carefully noted upon.

In conclusion, it may be mentioned that Messrs. Lawes and Gilbert have now in preparation a full report on the results of these experiments, in which the whole subject will be most exhaustively treated.

21.—NOTES ON BIRDS OBSERVED IN 1878.

By JOHN E. LITTLEBOY.

[Read 12th December, 1878.]

It will, I think, be remembered that I was requested about a year ago to preserve a record of all the rarer birds observed or shot within our district. I have now to announce eight species not previously reported.

1.—THE CROSSBILL (*Loxia curvirostra*).—I am informed by Dr. Brett that a specimen of the common crossbill was recently shot in a garden at Harrow Weald. Notwithstanding its name, it is a decidedly rare bird. It is described as being about the size of a hawfinch, and as conspicuously differing from all other species of English birds in the extraordinary shape and character of its beak. Buffon has described this strange formation as “an error and defect in nature,” and as “a useless deformity.” I imagine that but few would be willing to admit the correctness of such a verdict; on the contrary, I find it stated by Morris that the bill of the crossbill “is most peculiarly and admirably adapted to the mode of life for which it was created.”*

2.—THE CIRL BUNTING (*Emberiza Cirlus*).—A ciril bunting was observed by Mr. Lake, of King’s Langley, during the month of November, near Chipperfield Common. It closely resembles the yellow hammer, but is readily distinguished from it by its black chin and throat.

3.—THE HOBBY (*Falco Subbuteo*).—A good specimen of this hawk was shot last year at St. Margaret’s, near Great Gaddesden. The hobby is one of the smallest of the hawk tribe, and is a migratory bird, arriving in England about the beginning of May and leaving in the autumn.

4.—THE SPOTTED CRAKE (*Porzana maruetta*).—On the 4th of last September Mr. Alfred Dyson shot a beautiful little spotted crake in the Colne meadows, near Watford. This species is somewhat smaller than the corn crake, it frequents damp, fenny meadows, generally hiding itself among reeds and long grass, and is but very rarely to be met with in Hertfordshire.

5.—THE CRESTED GREBE (*Podiceps cristatus*); and

6.—THE RED-NECKED GREBE (*Podiceps rubricollis*).—In my supplementary notes on the “Birds of our District,” read last year,† I mentioned the occurrence of the dusky grebe on the Tring Reservoirs. I further stated that my friend, Mr. F. Harris, believed that he had also seen the red-necked grebe on the same waters. I am glad to be able to state, on the unquestionable authority of the Rev. H. Harpur Crewe, of Drayton Beauchamp Rectory, that this bird is occasionally to be met with in the locality mentioned, and it is therefore highly probable that my informant

* ‘British Birds,’ vol. ii, p. 341.

† ‘Transactions,’ Vol. II, p. 36.

was correct in his impression. I am further informed by the Rev. H. H. Crewe that the crested grebe is a frequenter of the Reservoirs, and I have recently seen two fine specimens of this beautiful species which were obtained from that district. Our group of the Grebe family is therefore, with only one exception, complete. The red-necked and crested grebes are both migratory, the former being a winter, and the latter a summer visitor.

7.—THE TUFTED DUCK (*Fuligula cristata*).—We are again indebted to our townsman, Mr. Alfred Dyson, for the record of a species new to our district. Mr. Dyson shot a pair of these birds, during the month of December, 1877, on the Colne, near Watford. The tufted duck is, with but rare exceptions, an exclusively winter visitor in the British Isles. It is distinguished, as its name implies, by a dependent crest of narrow black feathers; its head and neck are black, the former, in the male bird, being slightly tinged with green; its back and wings are nearly of the same colour, but the latter are crossed by a white streak. It is common during the winter in Yorkshire and the north of England, but is much scarcer in the midland and southern counties. It is stated by the Rev. C. A. Johns that the flesh of the tufted duck is less fishy, and consequently more palatable than that of most of its class, "being held in the estimation of French gastronomists as *un rôti parfait*."

8.—THE GOLDEN EYE (*Clangula glaucion*).—I have to thank our President for informing me of the recent capture of a pair of these ducks in the Bushey meadows. The golden eye is a regular winter visitor in the British Isles, but is by no means common in the midland counties. A nest of young birds is said to have been found in Sutherlandshire;* but the golden eye generally breeds in high latitudes, and is remarkable, among ducks, on account of its peculiar habit of building in the holes of trees, frequently at the height of 10 or 15 feet above the level of the water.

I have also recorded, as requested, sundry notes respecting the periods of arrival in this district of different migratory birds, and a few fresh particulars respecting some of the rarer species. I extract the following from my memoranda:—

THE NIGHTINGALE (*Daulias Luscinia*).—First heard by Miss Wilson, at Watford, on the 17th of April; at Hunton Bridge, on the 20th of April; at King's Langley on the 21st of April; and at Ware, by Lieut. R. B. Croft, on the 22nd of April. The nightingale has been much more abundant during the summer of 1878 than during the preceding year.

THE REDSTART (*Ruticilla Phœnicurus*).—Seen near King's Langley on the 18th of April.

THE WHEATEAR (*Saxicola Œnanthe*).—I was fortunate in identifying a wheatear on the 19th of August, in a field at the back of St. Andrew's, Watford; it is the first I have seen in this district. On the same day two were observed by Mr. Barraud on the

* Harting, 'Handbook of British Birds,' p. 66.

railway, near the old Watford Station, and on the 9th of September two were observed near the Hoo, Great Gaddesden, and another has since been seen in the low meadows near King's Langley.

THE SONG THRUSH (*Turdus musicus*).—During the past year the song thrush has been wonderfully abundant. As a proof of the mildness of the early part of the year 1878, I may mention that a nest with eggs was taken near King's Langley Common on the 28th of February. On the 13th of last month, and on several occasions since that date, I have heard a thrush, apparently in full song, in the garden at Hunton Bridge.

THE FIELDFARE (*Turdus pilaris*).—During the winter of 1877-78 fieldfares were unusually scarce.

THE RING OUZEL (*Turdus torquatus*).—I stated last year that I had seen one of these birds on the 14th of November, near the turnpike road, between Hunton Bridge and King's Langley. On the 3rd of last month I again observed a beautiful specimen, hopping about within twenty yards of the spot at which I had seen it in 1877. I believe it was accompanied by a female bird, but of this I cannot speak quite positively. The coincidence appears to be extraordinary. Is it possible that the ring ouzel frequents precisely the same localities on each returning journey from its northern home? Mr. Parkhouse informs me that, only last week, a ring ouzel, together with other birds, came to feed from crumbs which had been scattered on the lawn before his house at Rickmansworth.

THE CHIFF-CHAFF (*Phylloscopus collybita*).—First seen at Hunton Bridge on the 27th of March, and at Chipperfield on the 29th.

THE REED WARBLER (*Acrocephalus streperus*).—This interesting little bird was identified by Mr. Thos. Toovey, in the meadows near King's Langley, on the 15th of June. I have already recorded the reed warbler as frequenting the Tring Reservoirs, but it constitutes an important addition to the birds of our immediate neighbourhood.

THE RED-BACKED SHRIKE (*Lanius Collurio*).—Seen during the summer on several occasions, but not nearly so abundant as last year.

THE YELLOW WAGTAIL (*Motacilla Raii*).—Reported to have been seen on the 17th of June in the low meadows near King's Langley. This is a scarce bird and should be very carefully identified.

THE GREY WAGTAIL (*Motacilla sulphurea*).—Tolerably abundant during the autumn at Hunton Bridge and elsewhere.

THE MAGPIE (*Pica rustica*).—A flight of five magpies, a rather unusual number in this district, was noticed in the month of November near Elstree Reservoir.

THE SWALLOW (*Hirundo rustica*).—First seen at Hunton Bridge on the 9th of April; at Hemel Hempstead on the 11th of April; at Ware, by Lieut. R. B. Croft, on the 15th of April; and at St. Albans, by the Rev. C. M. Perkins, on the 22nd of April.

THE GREAT SPOTTED WOODPECKER (*Picus major*).—This beautiful, but rare bird, was recently seen by Mr. Barraud near Elstree.

THE GREEN WOODPECKER (*Geococcyx viridis*).—A pair of these birds were well identified in the plantation, near my garden, at Hunton Bridge, on the 6th of last August. They flew away together in the direction of Langleybury, and we have not since seen them.

THE CUCKOO (*Cuculus canorus*).—First heard at Cassiobury by Lord Essex, on the 22nd of April; by Dr. Brett on the 24th of April; and on the same day, by Lieut. R. B. Croft, at Ware.

THE NIGHTJAR (*Caprimulgus europæus*).—Two young birds were observed in the garden at Hunton Bridge on the 13th of September.

THE SWIFT (*Cypselus apus*).—First seen at King's Langley, near the church, on the 5th of May; and at Ware, by Lieut. R. B. Croft, on the 17th of May.

THE TURTLE DOVE (*Turtur auritus*).—We noticed turtle doves in our garden, on several occasions during the summer, but on the 3rd of September a nest, with one young dove, was discovered in a tree near the waste-water. Directly it was disturbed the parent bird attempted to divert our attention by scrambling along, as if desperately wounded, across the meadow; on reaching the stream she at once flew across without the slightest difficulty, but whilst crossing the grass-plot completely tumbled over four or five times. I had never before witnessed so remarkable a performance, and I could not but wish that it had been possible to assure the distressed mother of the perfect safety of her offspring.

THE SHORT-EARED OWL (*Asio accipitrinus*).—A beautiful specimen of this bird was shot about a month ago by Mr. D. Hill, at Northwood, near Pinner.

THE KESTREL (*Falco Tinnunculus*).—I have again to report that a brood of young kestrels was reared during the summer in an oak tree at Russell Farm. A remarkably fine bird was noticed on the 5th of October near Langleybury, and on the 29th of October another was observed chasing a rook in the neighbourhood of Pinner.

THE COMMON SANDPIPER (*Actitis hypoleucos*).—Reported by Dr. Brett as seen in Bushey meadows.

THE WOODCOCK (*Scolopax Rusticola*).—Two birds first seen on the 8th of November by the Rev. H. R. Peel, near Abbot's Hill.

THE COOT (*Fulica atra*).—Abundant on the Tring Reservoirs. A specimen was shot on the Colne by Mr. A. Dyson only last Friday.

THE COMMON GULL (*Larus canus*).—During the past year I have repeatedly noticed flights of gulls sailing over Hunton Bridge. On the 24th of August I counted a flight of twelve birds.

I will only say, in conclusion, that I should be extremely obliged to the members of our Society if they would more generally assist me by forwarding information respecting birds observed in their several localities. By so doing they would add greatly to the interest and intrinsic value of any future notes.

22.—POISONS NOT ALWAYS POISONS.

By JOHN ATTFIELD, Ph.D., F.C.S.

Professor of Practical Chemistry to the Pharmaceutical Society of Great Britain, etc.

[A Lecture delivered 9th January, 1879.]

ABOUT this time last evening, our Secretary called upon me and told me that the lecturer whom you expected to address you to-night was unable to fulfil his engagement, and paid me the compliment of asking me to read to you a paper, or deliver a lecture in the place of Mr. Lobley. Seeing that original papers are not produced at a notice of twenty-four hours, or seldom in that number of days, or even weeks, I need not say that I at once declined to produce for you the result of any original unpublished investigations. But your Secretary suggested, with that cool boldness which is characteristic of most Englishmen, and I am sure characteristic of good secretaries, that, nevertheless, probably in twenty-four hours I could think over a subject which might answer the purpose. In accordance with his suggestion, I looked up matter which I thought might be interesting enough to bring before you; and if you will allow me to call it a lecture—it will be a very short one—and if you will grant some indulgence to one who is quite unaccustomed to lecture at all, you will enable me to tell you something of what I have observed myself and have, indeed, already partly published. Were I to read a paper, I should not think of offering you matter that I had previously made public.

The subject is one that, in the title, at all events, would appear to have no connexion, or very little, with the objects of this Society; though I could, perhaps, give it a title which certainly would link it strongly to Natural History, and that would be, "Some observations on three new species of animals." The class to which these animals belong is common enough. An allied species is particularly common, for you meet with specimens at almost all dinner tables, in a piece of good old cheese. But I should not like to speak from the point of view that title suggests, because I should soon be wading into the systems of Natural History, and as I am not a naturalist, I should very soon be out of my depth. If I may treat of these little animals from the standpoint of "Poisons not always Poisons," I shall be more at home, and, I trust, you will be more interested.

I had occasion, a few years ago, to examine what medical men commonly term "medicinal extracts." An extract, in the sense of which I shall speak of extracts to-night, is simply an evaporated infusion or decoction of some herb. I need not remind you that the common sweet termed Spanish liquorice is an extract. Liquorice root is infused or boiled in water, the fibre is thrown away, the water boiled off, and you have Spanish liquorice as the extract. I desire to speak to you of such extracts. For instance, the common

plant termed henbane is infused or boiled in water, the juice is pressed out of it, and the watery parts are all boiled away; the residue is the common medicine, extract of henbane. Now I think you will see that if any soluble substance, such as a piece of sugar, is dissolved in such an infusion, decoction, or juice,—say a lump of sugar in ordinary infusion of tea,—and if you stir the liquid well and boil it down until all the water is gone, the extract which remains will contain in *every* portion of it a particle of sugar. So with infusions of such poisonous plants as henbane, belladonna, and others. When infusions, decoctions, or juices of these plants have been evaporated down, the water all boiled away, and you get remaining an extract, I think you cannot conceive any particle of that extract which does not contain a portion of the poisonous principles of those plants. The bearing of these remarks will be obvious to you directly.

Amongst the extracts I examined, was that of a very poisonous plant, *Strychnos Nux-vomica*, from which is derived that powerful poison strychnine. If you infuse the seeds of *Strychnos Nux-vomica* in water, you will dissolve out of them their strychnine, and if then, throwing away the exhausted seeds, you boil down what is left, you will have an “extract of nux-vomica,” and the whole of that extract, even the most minute portion of it, will contain strychnine. On such extract I found, especially on examination with a lens, numbers of mites. These mites had obviously eaten, nay, were actually eating, the extract. The conclusion was irresistible that they had eaten and were eating strychnine. They were sufficiently like ordinary cheese mites for me to infer that they really were mites, and belonged to the insect-like class of Arachnida, which having eight legs instead of six are not true insects. These little animals—though, even to my unpractised eye, obviously mites—did not resemble ordinary cheese-mites very closely. I examined some other extracts, and the extract of colocynth, a well-known medicine, furnished me some mites. I also obtained some from other sources, and found that the different communities of mites differed considerably.

With the object of ascertaining the exact nature of the different mites, I submitted specimens to Professor Busk, and he came to the conclusion that there were three mites previously both generically and specifically unknown—that I had, in short, by an accident, discovered three new species of animals. Two of them probably belonged, he said, to the same genus, but the other did not. So that I had even discovered two new genera. Under some circumstances, that would be a grand thing to do; but in this case the honour was almost thrust before my eyes, or, if achieved, was an honour that I think could be achieved by any one who possessed a magnifying glass, not to say a microscope, and had interest enough to examine some of the many things common on the road-side, in the garden, or even in their own household. Before I leave the Natural History part of the matter I should like just to tell you, what Mr. Busk told me, that there are two or three special points of interest about

these mites. In the drawings now shown,* Fig. 1 represents a mite from extract of *Taraxacum* or dandelion; Fig. 2, one from extract of colocynth; and Fig. 3, one from extract of nux-vomica. It will be noticed that Figs. 1 and 2 have not only eight legs, but a pair of claws, very much like those of the lobster. The mite from extract of colocynth (Fig. 2) has also two very curious eyes; for each eye, that is, the actual eyeball, has branching or growing out from it three little feathers, shall we say spikes, of

Fig. 1.

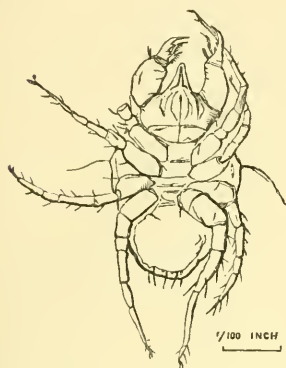


Fig. 2.

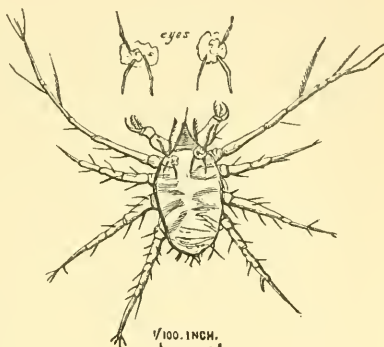
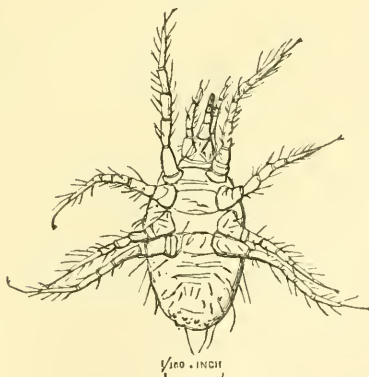


Fig. 3.



considerable length—twice as long as the eye is broad. This to my mind seems to be particularly curious, I having always regarded the eye as something very tender, always to be kept moist and so on, and having shutters to it. Then the first pair of legs are branched in every direction, almost like twigs of a tree. The mite

* For the loan of the blocks from which these figures are printed we are indebted to the Council of the Pharmaceutical Society of Great Britain.—Ed.

from the, to us, poisonous extract of *nux-vomica*, and the whole colony of which he was a member, had eaten a very considerable quantity of the extract. On carefully separating a piece, and putting it into a glass vessel with a large number of the animals, and setting it by for a few weeks, I found that at the end of the time they had eaten nearly the whole of the lump. It was quite obvious therefore—for I analysed the *nux-vomica* extract and found it was strong and good—that the mites were living and thriving on strychnine, one of the most virulent of poisons to man, and animals generally. This seemed to me particularly remarkable; and with my natural taste for experimental science, I proceeded at once to put some of these animals on to pure strychnine. I powdered up some strychnine as finely as I could, and shut up several of the little creatures with it, to determine whether they could eat it and thrive or would die. In those days—nearly twenty years ago—there was no Vivisection Act; over-legislation had not gone so far as that, or I might have been prosecuted for cruelty to animals. Well, they ate it with avidity, and grew and thrived and multiplied, little, if any, slower than in their old home. So I thought it was pretty clear that I had found some animals to which virulent poisons such as strychnine were, as one might say, bread and cheese. One's tendencies induced one to endeavour to ascertain whether the *nux-vomica* mites, living on strychnine, would live on our bread and cheese also. I treated them to some Stilton cheese, and they ate it with avidity, and grew on it. So, looking at things from a human point of view, I was led to inquire whether, these poison-mites relishing cheese, cheese-mites would relish poisons. I procured a pillboxful from a cheesemonger, and at once set to work to induce them to eat strychnine, morphia, and some rare poisons. They all died. You see the change of diet was too sudden. I therefore mixed up some cheese with 10 per cent. of strychnine. Cheese-mites ate that quite easily. I then gave them 25 per cent., and they lived and thrived on that; then 50 per cent. Perhaps I was not patient enough; the half-cheese half-strychnine killed them. I then again tried similar experiments with the other mites, and found that they would eat these poisons to almost any extent—live for months on cheese containing pure strychnine or pure morphia.

It was suggested to me to make some experiments on other animals. Well, I tried the poisons on animals almost as common—in London at all events—as mites: on black beetles. I thought they were fair game, and think so still—in spite of a soft heart and the Vivisection Act. I did not get on with black beetles. Perhaps they possess a nerve-organisation somewhat similar to our own, and different to that of mites, for they are thrown into violent convulsions and get killed by strychnine.*

* Possibly insect larvæ freely eat so-called poisons. See 'Pharmaceutical Journal,' May, 1862, p. 580. Toads and frogs are said to be indifferent to the action of prussic acid. See 'Pharmaceutical Journal,' March, 1862, p. 456.

I think the interesting point here is, the illustration afforded to the fact that a substance which is a virulent poison to one animal may be the food of another. That of course brings to our minds the allied truth, that poisons, such, for instance, as tobacco or opium, if used and persisted in for a length of time, can be borne by the human system pretty easily. I do not want to be hard on tobacco, because I am not a smoker myself and therefore possibly prejudiced. And I need not remind you what an enormous quantity of laudanum and other equally poisonous opiates are taken by individuals who have accustomed themselves to the use of such drugs. I have seen more than one or two persons drink off a wineglassful of laudanum and be none the worse: indeed, much the better,—for whereas they came into the room trembling, with hands shaking violently, a few minutes after they had taken their glass they became quite calm and got into their normally, or rather abnormally, quiet condition. Many animals are known to eat poisonous substances, and apparently enjoy and thrive upon them—vegetable substances, I mean, well known to be poisonous to man.

Soon after I had published among a few scientific friends a short paper on the subject of these mites, several persons kindly wrote to me and drew my attention to cases where, following my hints, they had found mites and such things living on poisonous substances. Mr. Hart, of Keyworth, sent me some mites that he found quite at home on extract of camomile, a very bitter substance; Mr. Baldock, now of Norwood, some living on extract of hemlock, and some on extract of belladonna; Mr. Jackson, of Crediton, some on extract of lettuce. I took the trouble to prove by experiment that there was plenty of the respective poisons in the extracts, and that the animals throve well on their food. One friend, Mr. Whipple, drew my attention to a most astounding case. I think I had better read the account to you, and then you can take it for what it is worth. I could scarcely believe it myself. One must hesitate, however, before coming to conclusions on matters of this kind. The poison mentioned is sulphate of zinc. Now sulphate of zinc is a mineral poison. Hitherto I have been speaking of poisons other than mineral. Although salt is a mineral, and although much of our food contains a little mineral matter, yet, on the whole, animal and vegetable matter forms our true food; mineral matter alone, noxious or non-noxious, is scarcely food. The account is by a Mr. Holt, and originally appeared in the 'Annals of Philosophy' for December, 1818, vol. xiv, p. 454: it is reprinted in the 'Pharmaceutical Journal' for April, 1862.

"A few months since, having occasion for some sulphate of zinc, I proceeded to examine my collection of metallic salts, amongst which I expected to find what I required. I readily found the paper, in which the label informed me the sulphate of zinc had been; but was much surprised to find none in it. A considerable quantity of minute particles of a yellowish-brown substance were scattered through the paper, some adhering to it, and all held together by an extremely fine silky thread. On removing the various papers, and searching to the bottom of the box, I discovered a portion of the sulphate of zinc, enveloped in a heap of the powdery substance. When I took it up a very large spider ran out of it, and

hid itself amongst the papers. The salt, with the exception of a thin shell, had been completely eaten by the insect. Never having met with or heard of a parallel circumstance, I was induced to investigate more minutely, with the view of discovering if I might not have been deceived. On recovering the spider I found it was of the species *Aranea scenica*.

"He had assumed a perfectly black colour; was, on being approached or disturbed, remarkably brisk in his motions; but at other times would drag his legs after him in a peculiarly sluggish manner. Having cleaned the box, I deposited the insect in it, with a lump of nearly two ounces of sulphate of zinc. In about ten weeks he had pierced this also; and, as usual, had produced a considerable portion of the powder. I then deposited other metallic salts, as sulphates of iron, lead, and copper, muriates of lead and mercury, and nitrates of copper and silver, with the sulphate of zinc in the box; but the spider did not leave the latter, nor did he touch either of the other salts, though I removed the sulphate of zinc for a time from the box. Being thus satisfied of the fact, I endeavoured to ascertain if the salt had undergone any chemical change in passing through the spider. I caused him to fast two days, then deposited him in a clean box, with 200 grains of sulphate of zinc; and when I perceived he had nearly eaten half of it, I carefully weighed the remainder with the powdery substance. It weighed 170 grains; here was a loss of nearly thirty per cent. This, however, might be in part water. I therefore collected sixty grains of the powder, on which I poured six ounces of boiling water. A considerable part remained undissolved, though frequently agitated, during two days. Ten drops of sulphuric acid were then added, and the whole was dissolved. It seems probable, therefore, that the sulphate of zinc has been deprived of part of its acid in passing through the spider.

"The insect at this time seems perfectly healthy, having eaten nearly four ounces of the salt in about six months."

This is a matter which a chemist could understand, if it could be understood at all. But I cannot conceive that an animal like a spider can exist on sulphate of zinc, and therefore I say you must take this account for what it is worth. At the same time, I should like to remind you that the atoms of the food we eat do their work in a physical manner. We cannot destroy anything any more than we can create anything, and if we take food, the molecules and atoms forming that food enable us to live and move, but then they pass away unaltered in total weight: it is during the alteration of form only that food does this wonderful work for us. As a matter of fact, it is animal and vegetable matter chiefly which enables us to live on and labour, but I do not suppose that we should look upon it as absolutely impossible that mineral matter should aid in the same kind of work under some circumstances, at all events for some animals. What I cannot conceive is that mineral matter alone, or even mineral matter and water, should do such work, unaided by animal or vegetable matter.

A peculiar case of poisoning was brought to my notice by a friend residing in Malta. He sent to me a cutting from the 'Malta Times,' giving the following account.

"WHOLESALE POISONING BY MILK.—On Sunday morning last most of the occupants of two of the first-rate hotels in Valetta, the Imperial and Morrell's, were seized with symptoms of virulent cholera. In the former hotel not less than twelve persons, including the landlord and servants, and in the latter seven persons, were attacked. Medical assistance was immediately procured, and appropriate remedies were applied. We are happy to state that the patients are now doing well, although for a time the violence of the symptoms led to apprehensions of a fatal result in many of the cases. From inquiries made it appears that all

the sufferers were seized within twenty minutes, to two or three hours, after breakfast, and that as the only article of diet common to all was milk, and as on other occasions of similar seizure the cause was clearly traced to that article, it is reasonable to infer that in the present instance the milk used for breakfast contained the poisonous ingredient. This conclusion becomes almost a certainty when it is known that several persons, living in the same hotels, who had not taken milk that day, escaped, while, without one exception, those who had taken it were seized with the alarming illness described. The family of Mr. Emmanuele Zammit, and, we believe, other families in Valetta, were attacked in like manner the same morning, after partaking of milk for breakfast; even a cat, which had taken some, showed the same symptoms of having been poisoned. Among the sufferers at the Imperial were General Bell, and Mr. Spence, the eminent sculptor, of Rome. Towards the end of last year a number of exactly similar cases happened at Sliema, where the whole family of a field officer, with one exception, was poisoned, evidently by goats' milk; and about the same time other cases occurred among the officers and men of Her Majesty's ships Marlborough, Algiers, and Firebrand, but with no fatal consequences. We have also heard of other cases occurring from time to time. Poisoning by milk, therefore, appears to be not an uncommon occurrence in Malta; but we are not aware if experiments were ever made by scientific men to ascertain beyond doubt the real cause of the milk assuming this dangerous character. The natives attribute it to the goats browsing on a particular plant belonging to the natural family *Euphorbiaceæ*, or spurge-worts, which they call *tenkhuta*, and which, they say, possesses the property of rendering the milk poisonous to human beings, without inflicting any serious injury on the animal itself. On the other hand, we have heard this popular belief ridiculed by some of the more learned Maltese physicians, although we must confess we never could perceive upon what grounds. We are glad to learn that His Excellency the Governor has ordered a searching inquiry into the matter, and we hope the result will be the adoption of means, if possible, to prevent such serious endangering of life by a common article of daily food for the future."—'Malta Times,' Jan. 22, 186—.

I wrote to my friend, and to the Editor of the 'Malta Times,' and they promised to let me know the result of the investigation. I believe the inquiries of the Committee landed them on no particular ground worth occupying.

Sir J. Emerson Tennent, in his 'Sketches of the Natural History of Ceylon,' referring to the mongoos and their not being liable to be hurt by poisonous serpents, says: "Such execeptional provisions are not without precedent in the animal economy; the hornbill feeds with impunity on the deadly fruit of the strychnos; the milky juice of some species of euphorbia, which is harmless to oxen, is invariably fatal to the zebra; and the tsetse fly, the pest of South Africa, whose bite is mortal to the ox, the dog, and the horse, is harmless to man and the untamed creatures of the forest." And again (quoting from 'Asiatic Researches,' p. 184), he says: "The hornbill abounds in Cuttaek, and bears there the name of *Kuchilakai*, or kuchilla-eater, from its partiality for the fruit of the *Strychnos Nux-vomica*. The natives regard its flesh as a sovereign specific for rheumatic affections."

Some interesting notes on "Poisonous Fish" will also be found in the 'Pharmaceutical Journal' for January, 1853.

I must lastly just refer to the practice—for it is a well-known practice in one part of the Austrian dominions—in Styria, of eating arsenic. This is another mineral poison, and for many years toxicologists seemed to be of opinion that the animal economy could

get accustomed to the eating of vegetable poisons, and perhaps animal poisons, but they questioned whether mineral poisons could be so absorbed without producing the usual effects. That is the opinion you will find recorded in all the old books and in the older editions of the current works on toxicology. But it is now certain, from impartial observations, that many persons do accustom themselves to eat arsenic. They take a piece of white arsenic—five, six, or even seven grains—and swallow it, and it produces no unpleasant effects at all. They begin when young with small quantities, but at last they are able to take at one dose the amount I have mentioned. The notion is that it improves the complexion of the lady portion of the community, and gives strength to the men.* These are all the cases I think it desirable to bring before you respecting the fact—for it obviously is a fact—of poisons not being always poisonous. They all support my conclusions respecting the poison-eating habits of the three species of animals I have introduced to your notice.

I bring this subject before the Society not only for its own intrinsic interest—and every new truth, however insignificant it may appear, is a distinct addition to the sum total of human knowledge, and must have its value—but in the hope that it may encourage even those members who have not had any previous special scientific training to make similar investigations. When I commenced these observations, I was quite ignorant of Natural History; but that did not prevent me from being sufficiently interested to follow them out. I am quite convinced that, without going from the four walls of one's house, one might, especially by the aid of a microscope, make many investigations of this kind. One might hope, nay expect, that members of a Natural History Society, many of whom are botanists and acquainted with the plants of this county, might also help to throw light on the question of the poisonous or non-poisonous properties of certain plants. The yew, for example. The yew has been said to be poisonous to animals, and there can be no question that it is so sometimes. It is quite certain that some animals have been seen to eat the yew, and have been killed by it. Animals have died and leaves of the yew have been found in them. It is also pretty clear that at least the stones of the fruit of the yew tree are more or less poisonous. I was chemically engaged in a case some time ago, in which the fruit of the yew had been eaten by children, who became very ill, one of them dying. That child ate a large quantity of the fruit, including stones. The probability is that the pulp of the fruit is not noxious, but that the stones are. But observations are wanted, and numbers of observations are wanted. In a large Society like this, doubtless some members have already made, or they may in future make, observations on plants like the yew, poisonous to

* See 'Pharmaceutical Journal,' vol. i, 2nd series, p. 556, and vol. ii, 2nd series, p. 337. Liebig's 'Theories of the Action of Poisons' will be found in the 'Pharmaceutical Journal' for November, 1841.

animals, and on plants said to be poisonous. Papers setting forth the results of such observations, or of experiments, would be appropriately communicated to this Society, and would be welcomed by all who are interested in the truths of Nature.

It is scarcely necessary to point any moral. Moreover, scientific men have a strong objection to the question *Cui bono*? At the same time there are doubtless different ways of viewing a subject of this kind. I will not make more comments myself, but with the view of relieving the somewhat dry details I have brought before you, I will give you what has been written by a rhymester on the point of view which possibly a mite might take of a microscopist, and then leave the subject in your hands.

A philosopher sat in his easy chair,
Looking as grave as Milton;
He wore a solemn and mystic air
As he Canada balsam spilt on
A strip of glass, as a slide to prepare
For a mite taken out of his Stilton.

He took his microscope out of his case,
And settled the focus rightlly.
The light thrown back from the mirror's face
Came glimmering upward brightly.
He put the slide with the mite in place,
And fixed on the cover tightlly.

He turned the instrument up and down,
Till getting a proper sight, he
Exclaimed—as he gazed with a puzzled frown,
“Good gracious!” and “Highty tighty!”
The sight is enough to alarm the town—
A mite is a monster mighty!”

From t'other end of the tube, the mite
Regarded our scientific,—
To its naked eye, as you'll guess, the sight
Of a man was most terrific,
But reversing the microscope, made him quite
The opposite of magnific.

“One sees the truth through this tube so tall,”
Said the mite as he squinted through it,
“Man is not so wondrously big after all,
If the mite-world only knew it!”

MORAL.

Whether a thing is large or small
Depends on the way you view it!

23.—MISCELLANEOUS NOTES AND OBSERVATIONS.

[Read 12th December, 1878.]

BOTANY.

Eucalyptus globulosa at Watford.—As this tree is attracting a good deal of attention just now, on account of its many valuable qualities, it may be interesting to record the result of some experiments in growing the tree at Watford. Mr. King sowed some seeds in a hot-bed on February 10th, 1874, and on July 18th the height was 17 inches. A plant was kept in a pot and protected from the frost till it was planted in the garden at Wiggshall, Watford, in June, 1877: it was then 13 feet high. It died during the following winter. One of the trees of the same age was given to the Rev. W. Walsh, who planted it in a sheltered corner of the St. Andrew's Parsonage garden. It was protected by matting. It lived through the winter of 1877-78. I saw it in September, 1878; it looked healthy, and it appeared to be growing fast. Miss Bailey Smith has one of these trees also. I saw it in her garden, Watford Fields, in October, 1878. It had been exposed two winters; it was very tall, and it looked generally healthy, but some of the leaves were brown, as if frost-bitten. In the winter it is protected by the boughs of fir trees. Among ourselves efforts to naturalise this tree out of doors have almost always failed, for the cold English winters and springs kill the saplings even in sheltered situations. *Eucalyptus globulosa* requires as mild a climate as the orange, its zone having now been pretty accurately defined by botanists.—*Alfred T. Brett, M.D., Watford House.*

Fertilisation of Aucuba Japonica. *—Possibly the explanation of Dr. Brett's *Aucuba Japonica* bearing berries, and Mr. Humbert's not, is this. The male blooms much earlier than the female, and requires to be kept back in a cold corner; the female most likely had a warm aspect, and the male a cold one. I have several male trees, and get plenty of berries on the females, grown side by side; but the pollen from the male remains active for a long time; I believe for more than a year, and is often carried a long distance, fertilising the female. Some of the male plants have leaves even more beautiful than the female. I have one which is so. The others are quite plain green; the berries at first are also a bright green, and the winter frosts seem to turn them red. The berries that are now on them are from last year. As these berries are likely through the introduction of male plants to become more common, it might possibly be wise to warn people if they are poisonous, which I think is likely.—*Ricardo Palmer, Bushey.*

* See 'Transactions,' Vol. I, p. 111.

24.—ANNIVERSARY ADDRESS.

By the PRESIDENT, ALFRED T. BRETT, M.D.

[Delivered at the Annual Meeting, 13th February, 1879.]

LADIES AND GENTLEMEN,—

The time has now come round at which it is my duty and my privilege to deliver the annual address. I think that I cannot better occupy the time allotted to me than by bringing under your notice the work done by our Society during the two years of my presidency, and then alluding to any subject in Natural History connected with our County. Afterwards, if time permit, I will continue the train of thought that I entered upon last year.

The work of our Society divides itself into two parts: first, the papers read in this room; second, our work as a Hertfordshire Field Club.

I will first enumerate the principal papers which have been read. In Meteorology we have had valuable papers from our Honorary Secretary; some observations taken at Cassiobury by the Earl of Essex, who is a most indefatigable and accurate observer of the weather; "Instructions for taking Meteorological Observations," by Mr. W. Mariott, Assistant-Secretary of the Meteorological Society; and Reports on the Rainfall, and on Phenological Observations in Hertfordshire, by our Honorary Secretary. This science seems about to emerge from the reproach from which it suffered in the time of Dr. Mason Good, who said of it: "Of all the subdivisions of general philosophy there is none so little entitled to the name of science as meteorology itself." We have had some valuable papers on botanical subjects. The Rev. George Henslow has given us one paper "On the Fertilisation of Plants," in which he expressed his opinion that his observations do not bear out the theory of Darwin on the importance of cross-fertilisation; and another learned and interesting paper "On the Origin and Present Distribution of the British Flora." We have also had a paper "On Microscopic Fungi," by Mr. Edward Chater; and we have had "Notes on some Hertfordshire Plants," by Mr. R. A. Pryor, who, I regret to say, has not been seen so often among us of late, owing, I believe, to ill-health. The Rev. Canon Gee, now Vicar of Windsor, has given us an interesting paper on "Famous Trees in Hertfordshire;" and Mr. J. J. Willis has contributed "Notes on the Botany of the Experimental Grass Plots at Rothamsted."

In Zoology we have had a paper "On British Butterflies," by the Rev. C. M. Perkins; "Notes on Economic Entomology" and "On the Observation of Injurious Insects," by Miss E. A. Ormerod; and "Notes on the May Fly," by Dr. Hood. We have had several zoological papers from Mr. Littleboy; one on the Fishes of the Bulborne and the Gade, with some account of those rivers; another "On the Birds of our District;" and another with some further notes on our birds. Mr. Littleboy has also taken some trouble in collecting notes and observations on birds recently observed in our county. Mr. Tuke also gave us some notes on birds observed at Hitchin. In other departments of Natural History, Dr. Attfield has given an interesting lecture on "Poisons not always Poisons," in which he gave an account of the discovery by himself of three members of the Arachnida tribe not before noticed; Mr. Harford has given us a lecture on "The Physical Characteristics of Minerals," most useful to mineralogists and geologists; and the Rev. James Clutterbuck has read a paper on "The Products of our County."

We set apart some evenings for special study with the microscope, but after a few nights the meetings were discontinued from want of interest shown by the members. I must say that I should like to see these meetings revived, for I think that our members do not show so much interest in microscopical study as they should do. The cabinet, also, that we have bought for microscopic slides, is far from being well furnished.

In our numerous field meetings we have been particularly favoured by fine weather. I shall not detain you by any remarks on the delightful visits that we have paid to Cassiobury Park and to Moor Park, to Hitchin, Hertford, Ware, Stanmore Common, Pinner, Boxmoor, Tyler's Hill, the Grove Park, St. Albans, and Hunton Bridge. I may mention that, amongst the rarer plants met with at these meetings, on one occasion we found Solomon's seal (*Polygonatum multiflorum*). It did not seem to be an escape from a garden. I have found the *Atropa Belladonna* growing wild, and have been told that it has also been seen a few miles from Watford.

But the most interesting discovery was that at Hitchin, near Mr. Ransom's house. The following account has been given in our 'Transactions,' p. lxi, in our Secretary's report on the Field Meeting at Hitchin:—"Here a number of flint implements, recently discovered in a bed of clay or 'brick-earth' a few miles from Hitchin, at once attracted the attention of Dr. Evans, who determined them to be celts of the Palæolithic Age, occurring.

under conditions which seemed to afford conclusive proof of an almost inconceivable antiquity. They were, he said, the earliest traces of the handiwork of intelligent beings which this country had so far afforded."

This interesting discovery tempts me to speak of that popular subject, the antiquity of man. But I must refrain, partly from want of time, but more from want of ability for the task, and because I hope, and have reason to expect, that we shall have a paper from the greatest living authority on this subject—Mr. John Evans. But I should like to record my opinion that the antiquity of man is very much underrated, not only by those who are not geologists, but even by geologists themselves. Besides, I have never heard any one bold enough to calculate geological time in years. We speak of ages and cycles and æons; but I want to see geological time reduced to our years, and then I can form a better idea of its duration. Mr. Evans even will not give a date. He says in the concluding words of his last address to us: "If you are mentally able to conceive the amount of time which would be necessary for producing such effects [some geological changes], I think you will agree with me that the antiquity of man is something which requires strong powers of our imagination to realise" ('Transactions,' Vol. I, p. 200).

I stated in my address last year that it was my opinion that in every solar year of about twenty-five millions of years our earth has a glacial period. If so, if we can find out how many glacial periods have elapsed since the earliest of the remains of man have been discovered, we have only to multiply the number of glacial periods by twenty-five millions, and it will give us the antiquity of man in years. I think it probable that man has been on this earth at least five or six solar years, say about 150 millions of years. I read in the October number of the 'Nineteenth Century' that "about two years ago Mr. S. J. B. Skerthly discovered in East Anglia oval flint implements of the Palæolithic type in the brick-earth." The brick-earth may be traced in places beneath the chalky boulder-clay. This boulder-clay is supposed to have been formed in the early part of the Ice Age, when the cold was at its maximum of severity. In the recent Paris Exhibition might be seen a collection of flints in a case on the wall. They were taken from beds supposed to belong to the early part of that stage of the earth's history which is termed the Miocene Period. In some parts of Switzerland beds of lignite or brown coal may be seen to rest upon deposits of glacial origin; while they are in turn covered by deposits of a like nature. Both the lower and the

upper beds prove that a rigorous climate prevailed at the period of their formation ; while the lignite indicates by its fossil plants a comparatively warm climate. These lignites are called interglacial lignites. Several cylindrical rods of firewood more or less sharply pointed at the ends lay embedded in the coal. These pointed ends seemed to have been sharpened by human hands. M. Broca says that Quaternary man is now-a-days better known than many historical nations. If we accept the doctrine of evolution, we must demand very great antiquity for man. It is difficult to calculate the great superiority of man when we consider the immense advantage he has in having the faculty of speech and a knowledge of the use of fire. To bridge over this great gap between the man and the ape would require almost incalculable time. But you may say that the theory of evolution is not proved, and that this want of the connecting link is a proof against it. You may say, Where is the intermediate man? Show me an animal half-ape and half-man. I may remark that it is not reasonable to expect uninterrupted geological evidence. For the history of the earth, as written in its rocks, is a most imperfect one. It may be compared to a book in which every alternate leaf has been torn out and destroyed. At best we have only the sedimentary rocks to examine. Of the land rocks from which these were probably derived we know nothing. I think that most likely in every solar year of twenty-five millions of our years, the relative position of the land and the water on the earth is changed. If you look at a map of the world, you cannot help remarking how much greater is the extent of land in the northern than in the southern hemisphere. Judging from the analogy of nature and from other facts, I think it probable that last year or the year before last (I speak of solar years), this distribution of land was reversed, and perhaps most land was before that time in the southern, and most water in the northern hemisphere. Most geologists believe in a submerged continent in the Indian Ocean, of which the island of Madagascar forms the remains. They call it Lemuria. I believe that our earth experiences a Lemuria every solar year, which probably contains the geological evidence of the missing link. We are told by geographers that the earth is raised on an average a thousand feet above the sea, and they calculate that it would take about six millions of years to denude and wash away all the land. Therefore, I think we may safely say that in twice that time, say half a solar year of twelve and a half millions of years, all the land would be washed away, and in another half solar year new land would reappear. In those parts of Great

Britain where the rainfall is greatest we have the older rocks exposed. For instance, in Scotland, Wales, and the English Lake District, where the rainfall is heavy, we have the Silurian and other old rocks at the surface, the more recent ones having been washed away. In Hertfordshire, where the average annual rainfall is about twenty-five inches, we have the Tertiary and Secondary rocks, the Silurian being underneath, as discovered at Ware. I have read that it is calculated that denudation is always going on at the rate of one foot in 3,600 years, at which rate all the land would be removed in about ten millions of years ('Science Gossip,' April, 1878). I mention this to show that the remains of the intermediate man may exist in rocks or formations at present submerged. I am inclined to believe in this theory of evolution, because it has for its support the testimony of the rocks, and explains many facts otherwise inexplicable.

Among the events which have occurred I may mention two very high floods that we had at Watford—one in July, the highest perhaps ever known. At the Nether Wyld it was one foot higher than the highest remembered, and it was remarkable for its sudden rise and its sudden subsidence. It was aggravated, no doubt, by the quantity of hay that was washed into the rivers and impeded the flow of the water. The Rev. James Clutterbuck and Mr. George Tidcombe, in letters to our local papers, have advised a plan of preventing the effects of these floods by sinking in various places swallow-holes into the Chalk. I am not enough of an engineer to give an opinion on this subject, but I think it is a suggestion well worth mature consideration.

I might mention that in the spring of 1877 hydrophobia created a great deal of alarm in Watford and in other places. This disease is fortunately rare in Hertfordshire, for fourteen local doctors whom I asked had never seen a case in our county. A short time after this two cases occurred; a child at Hemel Hempstead and a man at Bushey. I saw the latter case, and I quite agree with Sir Thomas Watson, who says: "No one who has ever seen a case of hydrophobia could mistake it for any other disease, or ever forget it." Last June I read a note on the fatal and singular disease among the deer in Cassiobury Park. My remarks were copied into some of the London papers, and soon afterwards this subject attracted a good deal of attention in the daily papers. Many suggestions were made by various writers, but I have not yet come to any satisfactory evidence of the cause of the disease. Some suggest that the deer may have eaten hemlock (*Conium maculatum*) or cowbane (*Cicuta virosa*). These are not common

plants in Cassiobury, and it would hardly account for the disease in the winter. It seems to be inflammation of the membranes of the brain and spinal cord, but why it should be epidemic I cannot say. In fourteen months about 120 of the deer died.

I should like to make a passing remark on what I consider some retrograde and ignorant legislation. I allude to the Act to amend the Act for the Prevention of Cruelty to Animals, commonly called the Anti-Vivisection Act. This is often considered to be a doctor's question, but it concerns the public more than it does the medical profession. I can speak with impartiality, because, although I have been a student of medicine for thirty-four years, yet I have never performed vivisection (except on the human subject), and I do not recollect seeing it done. Yet I can quite understand that to those who wish to extend the boundaries of knowledge it is an important means of research, and such students of nature should have every encouragement and help given them. For a knowledge of the laws of life is necessary for the treatment of disease, and if the public wish to keep the science of physiology imperfect, and succeed in their object, the treatment of disease will be more imperfect, more painful, more prolonged, and more expensive than it need be. As to cruelty, I do not believe it. Nothing is so cruel as ignorance, and those who wish to hug their ignorance of biology are the truly cruel. If the public knew their own interest, instead of listening to the blatant cry of a few amiable but misguided sentimentalists, they would establish physiological laboratories in every large town in the kingdom. There are very few sciences that would be likely to yield such grand results as physiology, and to pay, not only in a pecuniary point of view, but in relieving human suffering, as well as that of the animal kingdom, for all future ages.

I may here remind you of the great honour and distinction that has lately been bestowed on one of the honorary members of our Society—by his being made a member of the Berlin Academy of Science—an honour very charily bestowed on foreigners, but affording evidence of the high regard in which Charles Darwin is held in Germany. May he long continue to enjoy all his well-deserved honours! Great as his reputation is at the present day, I feel convinced it will be greater in the future.

In my address last year, I brought before your notice some facts and some speculations under the title of "A Sketch of the Plan of Nature," and endeavoured to show that there seemed to be a law that all things should move in a circle. For, taking for granted that force and matter are indestructible, and that they are always

in motion, they probably move in a circle, and perpetual circular motion is probably a law of Nature. It is to my mind as difficult to conceive of any body stationary in space as that time should be stationary; in fact, time is only measured motion.

My examples last year were taken from healthy Nature; I propose this evening to endeavour to show that the same law is to be observed working in diseased Nature. It may seem to some that it is out of place to mention disease in a Natural History Society. I hope a little consideration will show that the subject is not inappropriate, and it may be useful; for our versatile Premier says: "The health of a people is mostly the foundation upon which all their happiness and all their power as a nation depends." I shall treat the subject as a physicist, not as a physician, and only deal in generalities.

The study of Natural History, as generally understood, has many charms and many advantages. It promotes health of body and health of mind; but for my part, I should not devote any time to its pursuit if it were not for its many practical applications—its use in our every-day life. I study, and I advise others to study, what may be called practical Natural History. We are travelling through this world for a short time with many fellow-creatures of the animal and vegetable kingdoms, and it contributes not only to our pleasure, but to our advantage, and to our profit, to become acquainted with the habits and instincts and various relations of our fellow-travellers, not only that we may make use of them for our personal pleasure and benefit, but that we may be useful to them also. I shall not detain you by mentioning the various studies that might be included under practical Natural History; they may suggest themselves to your minds. I may mention that the diseases which affect the silk-worm, the vine, the hop, and the potato, the no-longer dreaded Colorado beetle, the Epizoa, and the Entozoa, are all a fruitful field for study. With regard to this subject, it has been said (by Andrew Wilson, in the 'Gentleman's Magazine'): "The field of inquiry seems well nigh boundless; and it should certainly form one of the most powerful arguments in favour of the study of natural science, that on the advance of our knowledge of economic botany and zoology the prosperity of our commerce and the conservation of our health may be shown largely to depend."

Nature may be divided into two classes, healthy and diseased. The same natural laws govern both, and the facts that we observe in the one throw light on the other. I shall not detain you with a definition of disease; but I may remark that I do not regard it as

an entity—a thing added to the body, as a poison requiring an antidote, or a demon to be exorcised; but as a condition, a state to be understood and to be treated according to the ordinary laws of Nature. Diseases may be placed in two divisions—necessary and unnecessary. The necessary diseases are those that we must more or less submit to in carrying out the law of circular motion. We must get our teeth, and lose them, and undergo many changes to reduce us to the grave.

“Nascentes morimur finisque ab origine pendet.”

It is a common saying, “Once a man, twice a child,” or, as our poet puts it :

“Last scene of all,
That ends this strange, eventful history,
Is second childishness, and mere oblivion :
Sans teeth, sans eyes, sans taste, sans everything.”

But the greater number of diseases are avoidable. The diseases of the young are in great part preventible. Epidemics carry off a large proportion of the healthy members of the community. The numerous diseases that arise from the abuse of alcohol are unnecessary. Accidents and military casualties should be placed here; for although war seems now the normal state of man, yet a state of society might be conceived by those gifted with imagination, in which war, and the accidents attending the water, the rail, and the mine, might be avoided. A number of diseases are produced by our acting contrary to the laws of nature. Nature will have her own way, and if we act contrary to her we must fall in the contest. If we wish to succeed we must obey; for we can only conquer Nature by obeying her.

I will not detain you longer on this subject. I will only glance at a few instances which seem to illustrate the law of perpetual circular motion. Dr. Elam says: “Evil is not eternal, nor disease; it has its natural history, its rise, its decay, and its disappearance.” And again: “As in all national departures from original types, due to special causes, there is a constant tendency to return to the type when the disturbing influences are removed, lapse of time or a succession of generations may purify the organisation, and then the curse may be removed.” Sir William Gull says: “Diseases are but perverted life processes, and have for their natural history not only a beginning, but a period of culmination and decline.” In common inflammatory afflictions this is now admitted to be an almost universal law. Time, and rest, that innate *vis medicatrix*,

“Which hath an operation more divine
Than breath or pen can give expression to,”

reduce the perversions back again to physiological limits, and health is restored. To this beneficial law we owe the maintenance of the form and beauty of our race, in the presence of so much that tends to spoil and degrade it. The effects of disease may be for the third and fourth generation, but the laws of health are for a thousand. Although this law of the *vis medicatrix nature* has been chiefly studied in human subjects, yet I think it may be equally seen to act throughout the animal, the vegetable, and the mineral kingdom, and the entire universe. In fact, I regard it as a part of the universal law of perpetual circular motion, in one case restoring a child to health, in another clothing the earth with vegetation, in another restraining and regulating the stars and the planets in their orbits. I shall not refer to Psychology; but it has been said: "The development of intellectual gifts has been by some supposed to follow a law of increase, culmination, and decay in races, strictly analogous to that which has been observed in individuals."

I ought not to pass over what is called the Germ Theory of Disease, not only because it supports my theory, but because it is of great practical use to us all, and besides, it affords a most interesting study to the naturalist. I can best explain what is meant by the germ theory of disease by stating what is daily taking place in Watford and in other towns. Many people make the following experiment. They ventilate the public sewers into their houses. They have pipes made; one end is made to enter the drain, the other ends in the bath or the housemaid's sink, or it is placed over the cistern of the drinking water. Then they warm their houses at night, so as to suck up the sewer gas, and when they are enjoying

"Tired Nature's sweet restorer, balmy sleep,"

they breathe these gases; and then, if disease comes on, they wonder how they could have caught it; and if they cannot find a cause, they think that it is a sufficient explanation to say that the disease is a dispensation of Providence. Sewage is very good food, excellent food, for plants. But if animals will partake of it before it has gone the circle through the vegetable kingdom prescribed by the laws of Nature, nothing but harm can result. Then, perhaps, two doctors are consulted, and one says that sewer gas of itself *can* create or originate fever; the other doctor says that it *cannot*, unless it carries with it the germs of some previous fever,—that you can no more get a fever without the germs of a former case than you can get an oak without an acorn. You here see how intimately connected are theory and practice. Germs are theoretical

things—no one has ever seen, or smelt, or heard, or felt, or tasted a germ; neither have germs been weighed or analysed. But in my opinion we may assume their existence from what may be called circumstantial evidence. It is said that germs cause fermentation, and that if you prevent the germs from getting to grapes or malt you will not have fermentation. And again, if you prevent the access of germs to a wound, or if you destroy them, you do not have suppuration or offensive discharges. Thus originated what is called antiseptic surgery, an invention only second to that of the sympathetic powder, in which the applications were made, not to the wound, but to the instrument that caused it. When our first *conversazione* was held in this building, I exhibited twenty glasses, each containing a different infusion. I placed in water twenty different substances, as cheese, bread, sugar, honey, walnut shell, etc. After a few days I examined the water with the microscope. My object was to find out whether the *animalculæ* varied according to the kind of infusion. I found the same kind of animal forms in each, although they varied in numbers and in size in the different infusions. Those from the honey and the sugar were the largest, those from hay most numerous, and the walnut shell afforded the least in number and in size. I therefore infer that the substances do not give rise to the *animalculæ*, but that the germs of them are floating in the air, and that the infusions only afford a suitable habitation and food.

A similar experiment is performed for us by Nature. In the summer, a few days after rain, you will find the puddles by the roadside become turbid. I noticed this very much last August, a very wet month with us, and I was surprised at the different colours presented by the puddles. Those on the roadside in Loates Lane were green, some at Aldenham, brown, and some at Bricket Wood, of a reddish colour. I cannot attribute this to difference of soil. I thought it might be caused by different organisms in each. I therefore examined them microscopically, but although all the waters teemed with life, yet I could not determine the cause of the various colours satisfactorily. I think there can be no doubt that the germs of these organisms were floating in the air. The subject forms part of the theory of Spontaneous Generation. The conclusion that I have come to on this subject is this: that spontaneous generation, speaking theoretically, is not only possible but probable; but that practically it has not been proved. Professor Tyndall says: "From the beginning to the end of the inquiry, there is not, as you have seen, a shadow of evidence in favour of the doctrine of spontaneous generation. There is, on the

contrary, overwhelming evidence against it." I do not deem spontaneous generation impossible, nor do I wish to limit the power of matter in relation to life; but possibility is one thing and proof is another. The method of nature is that life shall be the issue of antecedent life. Sir William Thomson has suggested that life may have arisen on this earth by having been conveyed on a meteoric stone from some other planet. I think this is a very far-fetched explanation; besides, it only removes the difficulty to another planet. I rather incline to the opinion that the absolute quantity of life in the Universe has for countless æons been the same, only varied in time and place. If spontaneous generation has ever occurred, we could not, I think, expect to see evidence of the beginning of life. The time man has been on this earth, even if we suppose it to be at least 150 millions of years, is too short, and the conditions of our solar system are, perhaps, not suitable at the present time. When I look at the sky on a starry night, I cannot help remarking two facts. Not only does one star differ from another star in glory, but the stars themselves are very unequally distributed; some parts of space seem to the naked eye to be free from stars, while in other parts stars are so numerous as to cause the appearance of what is called the "Milky Way." If, then, ponderable matter is unequally distributed through space, it is possible that imponderable matter or force is also unequally distributed. There may be belts or zones of force. Infinite space may be imagined to have a variety of climates, if I may use the expression. I can imagine that in some regions of space the force, and therefore the heat, is so intense that some solar systems may be destroyed, and that amongst them

. "The great globe itself;
Yea, all which it inherit, shall dissolve;
And,"

become nebulous matter, or what the Germans call cosmic gas. This comet-like matter may, after a few solar years, subside or cool into new solar systems when the climatic conditions of space are suitable thereto. If our minds could grasp the extent and duration of the universe, I conceive it probable that we might be able to predict the reduction of our solar system to nebulous matter, and also its reconstruction, with as much exactness as astronomers predict a solar eclipse on the advent of a comet. It is probably coincident with an Aleyonic year—a year of our sun's sun. Such a change, great as it is, may be considered only a slight momentary incident in the history of creation. Again, our sun, or

perhaps our sun's sun, in going his rounds, may experience in some places so great an amount of force that the numerous suns which attend him, in making use of it, may create so much heat that life in all the solar systems may be burnt out, the firmest rocks vitrified, and all water evaporated. After a time the suns may come into a part of space where force is so deficient that all life may be frozen. I can imagine that Aleyone and our sun, with others that circulate round him, may come again into a part of space where force is just of the right amount for life, and then I can conceive it possible that life would spontaneously arise in obedience to the laws at first impressed on imponderable and ponderable matter by the Omnipotent Creator. I do not imagine that life would suddenly arise. The immense interval which separates the living and the non-living, I think, would be too great for that, and the first appearance of life I should expect would be ultra-microscopic. But this is, perhaps, vain speculation. I must get back to disease.

When a germ once gets entrance into our body by our breath, or by our drinking a solution of sewer gas, it undergoes a period of incubation or vegetation, and it causes a regular round of changes in obedience to the law of circular motion. With regard to the *Trichina spiralis* (a pretty object under the microscope), when the germs or ova are eaten in raw meat, they have on more than one occasion caused a fatal epidemic. I have read that "this little parasite was first discovered at St. Bartholomew's Hospital." I think this an error, for I distinctly recollect having *Trichina spiralis* pointed out to me in the dissecting room of Guy's, in October, 1847, and I was told that it had been discovered some years before by that eminent surgeon and anatomist, the late John Hilton, whom we may regard in some sense as a Hertfordshire man, as he began his professional career at St. Albans. I must not pursue the subject of the plan of disease any further; I will only quote Dr. Mason Good, who, when speaking of the critical days in fever, says: "If we examine the phenomena of the animal economy as they occur in a natural series, we shall find that they are in almost every instance governed by a periodical revolution."

The theory I have brought before your notice I have only sketched in faint outline, and I have not attempted proof. If I had time and ability, I should like to investigate the subject from various points of view. I should endeavour to find out the number of the distinct glacial periods, and try to discover any periodicity in them, and what relation in geological time they bore to each other and to the astronomical position of the sun. I should study

the strata of the earth, especially the submergences the earth has undergone, and discover, if possible, the relation between the change of elevation of the land and the climate of the sun. With regard to the geological fauna and flora, although I should find a certain resemblance running all through the animal and the vegetable world, yet I should probably find distinct types, and I should expect to see these types in certain regular cycles of time. I should find some animals coming in and some going out, being probably influenced by the cosmical climate. The same with regard to the flora. Certain ideas run through the vegetable as they do through the animal kingdom; yet I should find a distinct flora peculiar to certain ages. The flora of the Coal Measures differs greatly from that of the present day, and even in times almost historical the flora of a country has changed, as is seen by those who have studied the Stone Age. I should expect to find that the flora and the fauna, the submergences of the land, and the various glacial periods, bore a relation and correspondence with each other, and also with that which I will venture to call the solar climate.

My theory does not claim the merit of novelty, for with regard to earthly affairs it seems to have been an accepted truth or maxim in the days of King Solomon, for he says: "The thing that hath been, it is that which shall be; and that which is done is that which shall be done: and there is no new thing under the sun."

I must now bring my remarks to a conclusion. In both my addresses I have indulged largely in speculative subjects, and I have done so purposely. We may discover truth in two ways—by deduction and by induction; we may form a theory and then search for facts to support it; or we may diligently collect facts and then form our theory from them. Before the time of that illustrious Hertfordshire man, to whose tomb in St. Michael's Church, St. Albans, strangers from all parts of the world perform pilgrimages, scientific thought was confused and lost in wild theory. I have read that this important question, "How many angels can stand on the point of a needle?" agitated the scientific world for ages. There came, about the time of Bacon, a revolution from this stage of thought. I suppose he was rather the exponent than the discoverer of the inductive philosophy, and that the time having come round, according to the law of Nature, for a change of thought, if he had not discovered it, some one else soon would have done so. Since his time we have pursued his method of the study of Nature, and with the most wonderful results. But I think I now see a tendency in thought, especially in England, to return more to metaphysical subjects; and indeed

I think it is time that some master-mind should endeavour to build into one system our vast accumulation of facts. To illustrate my meaning, let us suppose that twenty of the larger buildings in London, with their contents, were thrown into a vast and confused heap, and that each passer-by threw on the heap a piece of stone or wood—without reference to its position. To this may be likened the independent and therefore sometimes apparently discordant contributions to our store of knowledge which are constantly accumulating. Of course, each student is trying to reduce his pet study into order, but I think without sufficient reference to the other sciences. We want a master-builder to take this immense aggregation of facts and build them into a vast Temple of Truth, symmetrical and beautiful in all its parts, where spiritual, moral, and physical truths may receive their due attention, without inordinate prominence to either; so that harmony and order may reign throughout.

Allow me to congratulate you on the prosperous state of our Society, and also on the appearance of the first volume of the 'Transactions.' We are much indebted to our Secretary and Editor, Mr. John Hopkinson, for the trouble he has taken; and the work does him great credit. I congratulate you also on my successor. It so happens that my presidency occurs between that of two most eminent Fellows of the Royal Society. If you can imagine an ordinary gas-lamp for a time endowed with feeling and placed between two electric lights of the most improved stamp, you can imagine the feelings of a small light like myself; for I have no pretension to any special knowledge of Natural History, and I must say with the poet—

"Into Nature's infinite book of secrecy
A little I can see;"

and a very little. Our past and future Presidents, you know, are foremost among men of science in their respective studies, and they have obtained so much the confidence of their fellows that they have been elected treasurers of scientific societies than which there are none more celebrated in Europe, our past president being treasurer of the Royal Society, and our future president being treasurer of the Linnean Society and the Geological Society. I anticipate a most useful and progressive career for our Society under the presidency of Dr. Gwyn Jeffreys.

25.—THE STUDY OF GEOLOGY.

By J. LOGAN LOBLEY, F.G.S., F.R.G.S.

[A Lecture delivered 13th March, 1879.]

IN endeavouring to explain the precise object and scope of geological investigation and study, I cannot do better than make use of the definition given by one of our greatest geologists, Sir Charles Lyell: "Geology is the science which investigates the successive changes that have taken place in the organic and inorganic kingdoms of Nature; it inquires into the causes of these changes and the influence which they have exerted in modifying the surface and external structure of our planet." This is the technical or restricted and modern meaning of Geology.

But let us, for a moment, consider the full and widest signification of the word Geology. It is composed or made up of two Greek words—*γη*, meaning the earth; and *λογος*, meaning a description or discourse about anything. Geology, therefore, in its most extended signification, includes a study of *everything relating to the earth*—its origin, as well as the phenomena which we now observe; its place in the universe, as well as its internal structure; the arrangement of the divisions of the surface, as well as that of the rocks of which the continents and islands are composed; the study of its ultimate elements, as well as that of its constituent minerals; and, indeed, even the study of the organisms to which the great mother-earth has given life. But the study of that which relates to the origin of the earth is included in Cosmogony, and all that relates to the position of the earth in the universe we call Astronomy. The study of the divisions of the surface is termed Geography, and the science that has to do with the composition of the matter forming the earth, and the properties of ultimate elements, is Chemistry; while we call by the names Zoology and Botany those departments of science which are devoted to the study of animals and plants. As geologists, we give our attention to those facts, phenomena, and appearances connected with the earth which are not taken cognizance of by any of the sciences I have just named. In other words, and to be explicit, Geology embraces the study of the rocks, their arrangement, contents, structure, and composition, and of the elevations and depressions of the earth's surface. It investigates the causes of the phenomena observed, and so inquires into the changes which have occurred since the origin of the globe, and which have had for their result the production of the earth as we now find it.

Geology thus restricted is, however, sufficiently comprehensive to admit of being divided into several departments. The department of the science which relates to the properties, arrangement, structure, and peculiarities of rocks, is called Petrology, from *πετρος*, a rock, and *λογος*, a description. The study of the organic contents of rocks, or the remains of animals found in the earth, and called

“fossils,” is Palæontology, from *Παλαιος*, ancient, *οντα*, beings, and *λογος*, a description. Palæontology means therefore the *study of ancient life*. The department of Geology which classifies the beds of rocks according to their relative position or superposition, and the indications of their fossils, is called Stratigraphical Geology. The department which embraces the consideration of the properties and composition of rock-forming materials, or minerals, is Mineralogy; and the laws which are observed during these studies, and the causes which are found to have produced and to produce geological phenomena, are called the Principles of Geology. But though Geology leaves several departments of a *complete study of the earth* to other sciences, it accepts aid from all, and one great advantage of its study is, that knowledge derived from the study of any other of the sciences can be made good use of in geological investigations. To Geology, indeed, all the sciences may bring their contributions of knowledge to aid in the correct reading of “the great stone book of Nature.”

Before speaking on the advantages of a study of Geology, I will pass on to a necessarily very brief recapitulation of the progressive steps made by the human mind towards the attainment of that position which our science has now reached. I will not occupy your attention with the ancient Oriental and Egyptian cosmogonies, though they are very interesting and contain many germs of truth; and I will stop but for a moment to remind you of the wonderful knowledge of the principles of Geology possessed by Pythagoras, and given to the world by Ovid in the 15th Book of his ‘*Metamorphoses*.’ Aristotle followed in the safe footsteps of Pythagoras, and taught that the present order of things is the result of forces of nature such as now exist, operating during the past in the same way as they are seen to be working in our own epoch. Strabo, too, taught that the land rose and fell, and that what was now dry land was once the bed of the sea, and wrote: “It is proper to derive our explanations from things which are obvious,” thus indorsing the Pythagorean philosophy.

After the commencement of the Christian era, however, we do not find a teacher of geological truth for many centuries; and scarcely a spark of light on this subject comes to us through the gloom of the dark ages. It is, indeed, wonderful to look back through the long vista of two thousand years and see brightly shining the lights of the ancient world, while nearer to us, and where we might have expected light, nothing but darkness exists. But in the sixteenth century, that age of the awakening of the human intellect, and in Italy, that land of greatness, Leonardo Da Vinci, the famous painter, disputed the supposed astrological origin of fossils, taught that they were the real remains of what had been living creatures, and perceived their true meaning, as well as the teaching of the rounded pebbles.

The origin of fossils, or the organic remains found in rocks, was long a subject of dispute, and gave rise to a multitude of absurd theories, some of which are very amusing; but the general

opinion seemed to settle down into the conclusion that they were the result of the Noachian deluge, and to question this was to expose the doubter to anathema. Indeed, the deluge was made to account for all geological phenomena, and Woodward, to whom geological science owes so much, for his foundation of the Chair of Geology in the University of Cambridge, and of the magnificent Woodwardian Museum, which is one of the glories of that University, taught that the deluge had dissolved the whole earth, which had been re-formed by deposition beneath the waters of the flood. In 1749, Buffon, although not crediting the deluge as the cause of geological phenomena, ascribed everything to the action of an universal ocean which existed before the advent of man on the earth: but for maintaining that water was working as of old, and producing the same effects as it ever did, he was required by the offended theologians of his day to renounce his views. Subsequently to the time of Buffon many philosophical observers in France, Germany, and Italy, propounded theories to account for the phenomena with which they were familiar; but the presumed necessity of limiting the operations of Nature to six thousand years prevented that approximation to truth which would otherwise have been attained.

Towards the close of the eighteenth century, Werner, the famous Professor of Mineralogy in the University of Freyberg, in Saxony, boldly declared his conviction that all rocks were the result of *successive precipitations* from a common menstruum or chaotic fluid: that granite and basalt were consolidated sediments, as well as sandstones and clays. Werner erred, as many of us do at the present day, in generalising from limited observation. He was not perfectly acquainted with the geological phenomena of his immediate neighbourhood, and had never travelled, and yet he taught from his very limited data what he considered were the principles of the formation of the whole earth. Werner's views, were, however, ardently supported by his devoted pupils, and his many enthusiastic disciples, who were called Neptunists, because they contended that all rocks were of marine or oceanic formation. But these views were as ardently opposed by those who, ascribing the formation of basalts, and intrusive rocks, to the action of fire, were known by the name of Vulcanists.

The battle of the Neptunists and Vulcanists had raged hotly and long, when, in 1788, Hutton published his 'Theory of the Earth,' in which he proclaimed the grand truth, long before taught by the Greek philosophers, that we have only to seek, amongst the forces and operations of Nature which are now acting, for the cause of all the phenomena observable in the present structure of our globe. Hutton rightly ascribed the sandstones and the clays to the deposition of sediment at the bottom of seas, and the intrusive rocks, the basalts, the greenstones, the porphyries, and the granites, to the action of fire; but in not admitting gradual subsidence of the land, and in supposing alternate periods of repose and general disturbance, he fell short of the truth.

I now come to William Smith, the father of British Stratigraphical Geology. He it was who, in 1790, in his 'Tabular View of British Strata,' first reduced the stratified rocks of Great Britain to order, and showed that groups of strata, or "formations," as they are called, may be distinguished and identified by the organic remains, or fossils, found in them. This discovery was of the greatest possible importance, since by showing us that during the formation of each set of strata there flourished a group of animals and plants on the earth, different from the group living when the next set of strata above or below was formed, it teaches us that the rocks have been formed during long and successive periods of time, and that all these periods, except the latest, were anterior to the commencement of the existence of the group of animals and plants which we now find inhabiting the earth.

Time will not permit me to speak of the many men whose labours for the advancement of geological science have shed glory on our country since the days of William Smith, but with the works of Sedgwick, of Lyell, of Murchison, of Fitton, of De la Beeche, of Phillips, of Morris, of Prestwich, and of many more, you will become acquainted if you give any attention to geological science, and I will not further allude to them than by briefly mentioning the three schools into which modern geologists have been divided—the Catastrophists, the Uniformitarians, and the Evolutionists.

The first of these schools of modern geologists, the Catastrophists, or Convulsionists, as they have been called, considered that although all geological phenomena can be accounted for by forces now operating, yet that these forces operated in the past much more energetically than at the present time, and that these forces acting with a hundredfold intensity, caused great catastrophes or convulsions, far exceeding in violence and extent any seismic event witnessed during the historical period, and that then were mountains upheaved and continents submerged.

The second school, the Uniformitarians, the great exponent of whose views was Lyell, maintain that not only are the forces now operating sufficient to account for everything that has been observed, but that they are sufficient even if they have never acted with greater intensity than now; that time, and time alone, is required to render possible the production of all geological phenomena; and that Nature works uniformly, that her laws never suffer change, never act with greater or less force, that the whole machinery of the universe is never accelerated, and never retarded, but that all is working continuously, unchangingly, and yet progressively.

The third and most recent school of philosophers are the Evolutionists, at the head of whom we have Mr. Herbert Spencer and Professor Huxley. Evolutionism readily admits that the present forces of Nature, working at their present intensity, are quite sufficient to account for all we see; but, it is argued, may not these forces, acting continuously for lengthened periods, produce a set of

circumstances, or state of things, which will bring new forces into play, which will produce a new set of powers acting differently, and perhaps producing similar results in less or in greater periods?

Permit me, now, to say a word or two on the use of what are called scientific words or terms. These scientific words are, I know, a terror to many, and prevent not a few from undertaking a systematic study of science. But they are by no means so formidable as they appear to the unaccustomed eye; the eye and the ear very soon become familiar with those that it is necessary to use most frequently; and when these are known, study is found to be greatly facilitated. Scientific words are precise terms used to express clearly-defined ideas, and they accordingly frequently prevent the necessity for the employment of a long phrase, a circumlocution, or even an entire sentence. When, therefore, a scientific word is used, the hearer knows at once exactly what is meant, and a precise and definite idea is without any difficulty immediately conveyed to the mind, which would otherwise have been required to be concentrated upon the endeavour to obtain the full and correct meaning of, perhaps, a long sentence. Another advantage which scientific terminology has over ordinary expressions arises from the fact that scientific words are usually made up of parts, each of which has a definite meaning, and that they are therefore very expressive and descriptive, and so greatly assist the memory. When it is borne in mind, also, that, being classical, they can be used in all languages, their great value and superiority over ordinary words and terms will be at once acknowledged.

Since our science relates to the earth and the materials of which it is composed, it is, in the first place, necessary that we should endeavour to obtain a clear and definite idea of the shape and size of the earth. We have all been taught at school that the earth is round, that it is a globe; and we have, moreover, been told that it is round like an orange. Now this latter statement is to be distinctly remembered. The earth is globular, it is true; but it is round, not like a ball or perfect sphere, but simply round like an orange; or, in other words, it is a globe slightly flattened at each side. To be more exact, the earth is an oblate spheroid or ellipsoid.

If we take a sphere made of wire, or any material not rigid, and cause it to rotate rapidly around an axis on which it is free to collapse, we shall see that the axial diameter, or the diameter around which the sphere is rotating or revolving, decreases in length, and that the diameter at right angles to the axis, the transverse or equatorial diameter, increases correspondingly. The sphere will consequently be slightly flattened at each side, and will thus assume the shape of the earth, the flattened sides of which are also at the ends of the axis around which it rotates, or at the north and south poles. The bulging out or increase of the equatorial diameter of the sphere, and the consequent flattening at the poles, are due to centrifugal force which gives to matter rapidly revolving a tendency to fly outwards. This supports the

opinion that the earth was at one time a fluid or plastic mass, or at least that it either has, or has had, a yielding exterior shell, or crust, and that the present shape of the globe is entirely due to the combined action of gravitation and centrifugal force. The amount of flattening at the poles is, however, very slight, as will be perceived from a consideration of the size of the earth, given in the following dimensions. The longer, or equatorial diameter, has been ascertained to be 7925·648 miles, and the shorter, or polar diameter, 7899·170 miles, so that the equatorial exceeds the polar diameter by 26·478, or rather less than $26\frac{1}{2}$ miles, which is not more than the 1-300th part of the diameter; the circumference round the equator, or in other words the length of the equator, is 24,912 miles; and the entire surface of the globe is computed to be about 197,552,160, or nearly 200 millions of square miles, and the cubic contents, 263,858,149,120 cubical miles.

These figures, however, great though they be, convey a very inadequate idea of the vastness of the globe on which we dwell. It has been estimated that were we able to see an entirely fresh portion of the earth's surface every day, and were we able to see on each day an extent of surface 80 miles in diameter, or an area of 5,000 square miles, it would require no less than 110 years to enable us to survey the whole earth even in this most rapid manner; or, again, were a man to wish to travel over every square mile of the earth's surface, at the rate of 30 miles every day, it would require 18,264 years for the completion of such a tour.

The calculations of astronomers have given us the weight of this vast globe with great accuracy, and we find that the specific gravity of the whole earth is about 5·5, or $5\frac{1}{2}$ times the weight of water, at 60° Fahr. The result of a calculation made by the Astronomer Royal is as high as 6·56, but the officers of the Ordnance Survey give only 5·32, and a very reliable one by Mr. Baily is 5·67. The majority of results approximate to the lower rather than to the higher figures above given, and we may therefore consider 5·5 to be very near the truth. Now, the specific gravity, or density, as it is termed, of ordinary rock-substances or of those substances which we find composing the earth wherever we can observe its structure, is 2·5. It is assumed from the weight of our globe that the interior is differently composed from that portion which has come under human observation. It is, however, because of the lightness of the globe, and not because of its heaviness, that this is inferred. For rocks, although having a density of only 2·5 at the surface, would, were they nearer the centre, have a greater specific gravity, which would continuously increase with approximation to the centre. The whole globe would therefore, it is said, were it composed entirely of the rocks we know, be very much heavier than we find it to be.

From this fact, from the flattening at the poles, from volcanic phenomena, and from the increase of warmth as we descend below the surface in mines, it is supposed that our world consists of a shell or crust, comparatively thin, and having the interior filled

with matter in a state of fusion. This view is, however, opposed by some of great knowledge and authority on this subject. But whichever opinion we hold as to the character of the interior of the earth, we may agree to call all that we can become acquainted with by actual observation, "the crust of the earth." This is the term which has been agreed to generally, although it was indubitably first used to indicate that the interior of the globe consisted of a fluid mass. We have therefore to deal with the crust of the earth, or, as I before stated, with all that we can see of the structure of the globe either at the surface or in excavations, mines, caves, or fissures. Of the composition of the central parts of the earth we can only at most infer, but of the composition of the crust of the globe, we have abundant opportunities of observation. And everywhere we find that this crust of the earth is composed of a variety of hard rocks, either homogeneous or made up of several distinct mineral substances,—of shales, of clays, of sands and gravels, with great masses of water, containing various salts, filling extensive depressions of the surface.

I must now ask your attention to the word "rock." This word, when used geologically, means any mineral mass forming a considerable portion of the earth's crust, whether hard or soft, whether compact or disintegrated, whether granite, limestone, sandstone, shale, clay, sand, or gravel. It may be used when speaking of the softest bed of sand as correctly as when referring to the hardest mass of granite.

The whole earth may consequently be said to consist, as far as we can discover by actual observation, of rocks and water. This is what we find from ordinary general observation; but when we observe more closely, and examine the rocks in detail, we find that they may be divided into two kinds by a very remarkable difference in their structure. We see that many of the rocks have a structure which is called stratified, that is, they are found to consist of layers, or parallel beds, or strata. These rocks are therefore called stratified rocks. But all rocks are not so; some we find devoid of any indication of stratified arrangement. These, therefore, we call unstratified rocks. All rocks are hence classed in two grand divisions, the stratified rocks and the unstratified rocks. The stratified and unstratified rocks form, with the water, all the globe that it is possible for man to observe. The rocks extend over the whole globe, but the water over only a portion, and always reposing upon and covering the rocks. The rocks uncovered by the water we call land, and the water we call sea. But the land and the sea are not in regular-shaped or compact masses; they are intermingled in an apparently most complicated manner, the land assuming a great variety of forms seldom regular, and the sea occupying the inter-terrestrial spaces. The study of the various portions of the land and sea is included in Geography, but the study of the relation of Geology to Geography, or the geological character and origin of the physical features of the earth's surface, is Physiographic Geology. This portion of our

science will therefore teach us the formation of continents and oceans, of islands and seas and lakes, of mountain chains and isolated peaks, cones, and hills, of wide-spreading plains, broad valleys, and deep ravines ; of, in short, all those grand features of this beautiful and diversified world which it is the especial province of the geographer to describe.

But are the land and the sea, though broken up and irregularly divided, equally distributed over the surface of the globe ? On the contrary, the land forms but one-fourth of the whole surface of the globe, and the water or sea three-fourths. Or, to be more accurate, out of the 197 millions of square miles of surface which the globe presents, only about 51 millions of square miles are occupied by the land ; the remainder, or about 146 millions of square miles, being covered by the oceans and seas of the world. We thus see how important water is geographically, and we shall subsequently see how important it is geologically. We shall see that water is the great operator on the exterior of the earth ; for water it is, put in motion by gravitation, by winds, by alterations of temperature, or by tidal influence, which has produced that configuration of the Earth's surface which we now see and enjoy.

The distribution of the land in the northern and southern hemispheres is also very unequal. Of the 51 millions of square miles of land which remain above the waters, three-fourths, it is estimated, are in the northern hemisphere, or north of the equator ; the whole of the dry land in the southern hemisphere not amounting to more than about 13 millions of square miles. So also, if we divide the globe meridianally into eastern and western hemispheres by a meridian running through the Atlantic Ocean, we shall find that much the greater quantity of land lies in the eastern hemisphere. Indeed, it is possible to divide the globe into two hemispheres in such a manner that nearly the whole of the land may be in one half and nearly the whole of the sea in the other.

This may be done by making England the centre of one hemisphere, and the antipodes of England, or New Zealand, the centre of the other. In the English hemisphere, if I may be allowed to call it so, we shall have the whole of Europe, Africa, and North America, very nearly the whole of Asia, and the greater portion of South America ; while in the antipodal or New Zealand hemisphere we shall find only the southern portion of South America, the East Indian Archipelago, and the Australian and South Sea Islands. Again we shall find that the land is nearly all continental—that is, continuous, and not in detached portions ; for if we exclude the island-continent, Australia, only 1-24th of the land consists of islands, all the rest, or 23-24ths, being continental. Not only is the extent of the surface of the sea much greater in the southern than in the northern hemisphere, but the depth of water is also greater ; abyssal depths prevailing in the one and comparatively shallow seas in the other. We see, therefore, that the amount of water is enormously greater in the southern than in the northern hemisphere.

This unequal distribution of the land and sea greatly affects the climate of the globe. Had the extent of land been greater, or that of the water less, or, in other words, had the level of the sea been lower than it is, a great part of the earth would have had too low a temperature to allow of the existence of either animal or vegetable life, since the rarefaction of the atmosphere and the cold increase with distance above the level of the sea.

We thus see what an important part in cosmical economy is played by the vast expanse of ocean, which some may be inclined to think a waste of surface. The climate of the globe would also be seriously modified by a different arrangement of the present extent of land; for had continents extended from east to west instead of from north towards the south, and had they been massed around the poles, the cold would have been extreme; and on the other hand, were the continents extended all round the equatorial regions of the globe, leaving the poles as the centres of vast oceans, the earth would have been uninhabitable by reason of the extreme heat.

What now is the cause of this beneficial distribution and arrangement of land and water? It is the amount of water on the globe, and the elevation, extent, and direction of mountain chains. The mountain chains of the globe form the skeletons of the land-surfaces, on which all the remainder of the land depends, for did not the great ranges of mountains interpose their barriers, the land would be worn away by the ceaseless action of the ocean's waves and currents, and did not the great chains of mountains supply *débris*, material would be wanting for the formation of the wide plains which form so large a portion of continental areas.

We see at once how the size and shape and position of America have been determined by the great range of mountains which extends from the north to the south of that vast continent along its western side, thus protecting it from the destroying action of the Pacific Ocean. On the eastern side of the Andes the land spreads out far to the eastward, permitted by the protection of mountains on the south-eastern coast of Brazil, and by the eastern direction of the currents of the Atlantic on the north-eastern coast. In the northern portion of America, a range of mountains parallel to the Rocky Mountains—the Alleghanies—gives a broad quadrilateral form to North America, with that wondrous valley on which the greatness and the glory of the Great Republic depends, the valley of the Mississippi. In Europe, the Alps, the Dovrefield mountains in Norway, the Apennines in Italy, the Pyrenees and the Sierras of Spain, have each evidently taken part in the determination of the form of the land. In Asia, the Caucasus, the mountains of Syria, and the great central range of the Himalayas, together with the high table-lands of Thibet and Tartary, form the framework of the continent. In Africa the relation of the form of the continent to the position and direction of its mountains is, from ordinary maps, less distinctly perceptible. And yet we can at once see that Table Mountain has determined the southern termination

of Africa, that the mountains of Abyssinia give us the plains of Egypt, that the Atlas range protects the desert of Sahara and the northern regions, and that the great central highlands give width to the continent.

But in our own island of Great Britain this relation of the form of the land to its mountains is conspicuously observable. On our western coasts, where the sea beats with great force, we have high lands and hard rocks, extending almost from the most southern to the most northern point, and thus our island is protected from destruction. The irregular outline of Scotland will be found to be intimately connected with the extent and direction of her mountains, and the same relation of the coast-line with mountains is to be observed in the north of England and in Wales, while the promontory of Cornwall is due to the uplifted masses of granitic rocks which characterise the south-west extremity of Great Britain. The east and south-east of England is formed, it is true, of comparatively soft rocks and low lands, without any bounding high lands except the South Downs. But these lands could not have existed had the sea been acting with the same destroying power as on the west coast. The sea on the eastern shores of England, although wearing away the cliffs in some places, is depositing and forming land in others, and on the whole is acting with comparatively little force. But even on this eastern coast of Britain, where we see a projecting headland, as at Flamborough Head, or at Scarborough Castle, somewhat harder rocks and more elevated land will be found than where the retreating coast-line forms bays and indentations.

And as the mountain ranges determine the form of the land, so also do they determine the climate, and the character of their adjacent districts, and even the occupations of the inhabitants. For it is the mountain chains which form the watersheds, and determine the size and the direction of the great rivers which form the plains and deltas, irrigate the land, and facilitate commerce. A watershed is of course the summit-line of a range of mountains, hills, or high lands. These watersheds or summit-lines are in many instances more effectual dividers of floras, of faunas, and even of races of men, than wide rivers or deep seas.

Watersheds form the boundaries of river-basins, and hydrographical areas, which are often very distinct geographical divisions of the earth's surface. Thus we have in America the great river-basins of the Mississippi, of the St. Lawrence, of the Amazon, and of the La Plata, forming very large and very distinct portions of the continent. So in Europe, the area drained by the Rhine is distinct in climate and productions from the area drained by the Danube, the Volga, the Vistula, or the Po. In England, too, we have the basins of the Thames, of the Severn, of the Trent, and of the Ouse, forming very well-marked portions of the kingdom.

When we reflect that all these great features of the globe on which we live, so profoundly important as they are to all the interests of the human race, are the result of geological causes, we

at once perceive how deeply interesting must the study of geology become to any one of ordinary intelligence. But it is specially interesting to students of other departments of human knowledge. To the astronomer it is interesting to know the constitution, and the composition, and the internal forces, with their operations and results, of one of that great brotherhood of heavenly bodies, the motions and the mutual relations of which it is his peculiar province to investigate. To the geographer it is interesting to know the character of the great mountains and the wide plains of the earth; to know the cause of the sterility of one portion of the surface of the globe and the productiveness of another; and to become acquainted with those stupendous operations of Nature which have uplifted the Himalayas in Asia as well as the Malverns at home, which have scooped out the great valleys of the world and produced those gorges of the Andes and the Rocky Mountains, where the traveller looks up with wonder and awe at precipices a mile high. To the chemist it is interesting to know the ultimate effects of those affinities and powers he delights to study; to know in bulk what he knows in detail, and to observe the occurrence in Nature of those substances he is so familiar with in the laboratory. To the zoologist it is surely interesting to know the forms of animal life which peopled the earth before the present genera and species appeared; to trace the likeness of an animal in one that lived in the far-off eons of the past, and to note the marvellous adaptability of every creature to the circumstances which prevailed during the epoch in which it had its existence. And to the philosopher is it not interesting to examine the evidences of the consistency of the Universe; to see that that wondrous whole which Astronomy teaches us the most far-reaching telescope cannot penetrate, nor of which the most capacious mind can conceive the limits, is not of yesterday, but that all is great, the time as well as the extent, the age as well as the size; and that all is fashioned as well as governed by the working of laws which inspire the mind with the utmost awe by their undeviating consistency and stately and majestic action?

The study of Geology is, however, something more than interesting and instructive to the student in his study. We can easily see how it will widen the mind and elevate our conceptions of Nature and her operations. But there is another object to be gained by the study of Geology, which, perhaps, I should have named earlier.

The use of a knowledge of Geology is evident in mining and engineering operations, whether for the supply of water to towns or for the making of roads either for civil or military purposes. By teaching the character of the subsoil of a district and of the underlying rocks, it is most useful in agriculture, and by teaching the character and capabilities of a distant country it may be made most useful in commerce.

To those engaged in city life, a knowledge of Geology is most valuable. It takes our thoughts at once away from crowded streets and busy workshops, to the mountains and to the sea. We hear no

more the noisy town, but listen in imagination to the ocean's roar, or the torrent's fall; or gaze on mountain peaks, and see the glacier and the avalanche doing their destroying yet preserving work, or on the sun-lit iceberg floating calmly on the ocean's breast, while it is melting and dropping its burden of rocks and earth on a future continent. Or we are taken at once to our own beautiful hills and vales, where we may see, in part at least, the faunas and the floras of the distant past.

When we look at a geological map of the British Islands, and observe the variety of colours indicating the many formations of which our country consists, and when we remember its limited extent, and the facilities which now exist for reaching every part, one feels that every inhabitant of the British Islands ought to have some knowledge of Geology. In no other country on the globe do the same facilities exist for the attainment of a practical acquaintance with almost every variety of rock, with almost every formation. We all travel now and then for one purpose or another—for business or pleasure—and on these occasions we can frequently find opportunities to study in the field the geological characters of the district we may happen to be in, and to spend a few hours or a few days in collecting the fossils of the locality, and so we may form a collection which will be both an interesting and a valuable addition to our household gods.

How much, also, does a knowledge of Geology add to the pleasure even of a pleasure excursion. A search for fossils is far superior to a fox-hunt; for we are taken through as beautiful, if not more beautiful, scenes, and may experience with almost equal keenness the pleasure of pursuit, while we have the consciousness, which ought to add an indescribable pleasure, that we are adding to our knowledge and not inflicting pain on the meanest creature. While traversing a strange district we shall not be as strangers; we shall feel that we possess an acquaintance, and even an intimacy, with every rock, with every hill and ridge we see; its birth, its history, its cause, the purpose it is serving in the economy of the world, and the part it is playing in Nature, will be known to us, and we shall feel at home in a strange land.

The cultivation of the habit and the development of the power of observation, which are amongst the rewards given by science generally to its votaries, are obtained in perhaps a greater degree from Geology than from any other department of the investigation of Nature. This and the other considerations which have been urged will, I trust, make it apparent that from the study of Geology many and great advantages will result, and that the subject is well worthy the consideration and attention of the members of a Society devoted to the observation and investigation of the natural phenomena presented by their country.

26.—BEES AND BEE-KEEPING.

By the Rev. HERBERT R. PEEL, M.A.

[Read 10th April, 1879.]

BEFORE I presume to read a paper to the members of a learned society, such as I have now the honour of addressing, upon matters connected with Natural History, to which science their attention and investigations are principally directed, I must disclaim any pretensions to the title either of a naturalist, entomologist, or botanist. My only qualifications for imparting information upon bees and bee-keeping are two in number. The first is that I have for some time past kept in a glass hive in my study at Abbot's Hill, a colony of bees, of the variety known as the honey-bee, whose nature and habits I spend a good deal of time in watching, and have, therefore, facilities and opportunities of seeing for myself what others may only be able to read of in books. The second is that from being the Secretary of the British Beekeepers' Association, as well as of the Hertfordshire County Association, which is an offshoot from, and affiliated to, the parent society, I am brought into frequent contact with that rapidly increasing variety of the genus *homo* known as the British bee-keeper, and so have an opportunity of watching and studying his nature and habits, which is probably not within the reach of many of my audience to-night.

It is right, I think, to speak of bees before we speak of bee-keeping. No one should attempt to keep any living creatures either for pleasure or profit until he has made himself thoroughly acquainted with their habits, and understands their wants and requirements. A gentleman who had purchased a swarm of bees from a well-known bee-master in London, late in the season, some years ago, refused to pay for them on the ground that the bees had deserted the hive in which they had been placed, and had gone off he knew not where. When the case was investigated in the Metropolitan County Court, it was proved that the bees had dwindled down and perished for want of proper attention and feeding. The defendant's defence was that he had no idea that he ought to have attended to, or fed the bees, upon which the learned judge stopped the case, and said that he must rule against him, as it was evident to him that any one keeping bees should have first learned how to take care of them, which the defendant clearly had not done.

We will then, to-night, follow in the case of the bee the advice which Solomon gives in the book of Proverbs respecting the ant. We will consider her ways, that we may be more wise than the defendant in the case just mentioned, and as I am not going to speak to you about anything of which I have not some personal experience, I must direct your attention mainly to the *Apis mellifica* or honey-bee. There are many other kinds of bees to be

met with in England. There are several varieties of solitary bees, which lay one egg in a little chamber at the end of a tunnel which they make in the ground, and store up with it a supply of pollen gathered from flowers, to be the food of the grub when hatched. There are, moreover, social bees, which live in families, such as the humble-bee, of which alone there are eighteen varieties. These make their nests in the ground, which proof of humility may have something to do with their name, if it does not originate entirely from the humming sound which the insect makes in its flight. There are many points of resemblance between the ways of these bees and those of the honey-bee. In all cases it is the female bee which lays the egg or eggs and rears the young brood; it is the female, also, which is armed with the sting, whilst the male bee is born defenceless; but there is on the other hand this great difference: as winter approaches the worker-bees of these families, as well as the males, all die off, and the mother, or queen, as we call her, does not attempt to pass the cold winter months in the nest, which she has constructed during the spring on the ground or elsewhere; but retires into the hollow of some tree or into the thatch of some roof to remain in a torpid state until the return of summer calls her to life again, when she commences her labour anew.

The queen-bee in one of our garden-hives acts very differently as the winter draws near. She has no intention of deserting the combs which her daughters have constructed with such care during the summer. A certain store of provision has been accumulated and laid up in the cells, and on this she relies to stand the siege of frost or snow. The worker-bees live on with her, but the drones or male bees are not to be found in the hive during the winter. Just as in the case of a beleaguered fortress, the governor or commander, before the enemy has entirely surrounded him, sends forth all useless non-combatants, who will only consume the stores without contributing to the defence; so, when the flowers droop and die down, and the days are shortening, and the winter commences the siege of the hives, the females or worker-bees give the drones notice to quit. The queen in the words of Shakespeare "delivers o'er to executors pale the lazy yawning drone." Out he must go; driven from home to perish from starvation and cold. He will not work, neither must he eat. If he resists, and refuses to go, he is dragged out by force or pierced by the stings of his sisters. Now it is seen why Nature has not armed the male bee with a sting, and why the loss has made him powerless against the attacks of his Amazonian sister. The drone might protest against this somewhat cruel sentence, and refuse to leave the hive where he is not wanted. One use, indeed the main use, of the sting given to the female is to enable her to guard her nest or hive, and to protect it from foreign invaders. In the summer the drone was taking his pleasure abroad instead of doing the work at home, or defending it. And here, perhaps, it may not be inappropriate to supply an answer to that often asked question, do humble-bees sting? Many persons are

under the impression that they do not. They say that they have often handled them without any unpleasant consequences. This must arise, I think, from the fact that in the height of summer, the time when people generally take most notice of these insects, they see more of the males than they do of the females. The male, who has no duties to perform at home, who collects no honey or pollen, secretes no wax, builds no cells, feeds no young, is like the idle and lazy husband of the working, or as they have been called, of the non-working class, who is to be seen oftener out of doors than in, generally not a hundred miles from the nearest public-house, whilst his wife, with his sisters, are working hard indoors, and striving to keep the home together. If any one doubts whether the female worker-bees have stings, at what the Americans call the business ends of their tails, or whether the hard-working wife of the idle labourer or mechanic has a sting at the business end of her tongue, a sting equally full of deadly poison, let him go and disturb either of them in the midst of their domestic avocations at home, and I think that his doubts will speedily be removed.

Let me tell you now how my own particular bees spent the late winter, after they had destroyed their drones. First of all, they took in the food with which I supplied them, after the flowers were all gone, and went on hatching out broods from the eggs which the queen kept laying until the cold and ungenial weather at the end of November seemed to deprive her of all energy and the bees of all appetite. Then they gathered themselves upon one frame. As many as could, crept into the empty cells, whilst the others sat upon the outside and kept up a continuous motion of their bodies with a view to generating heat. The temperature of this part of the hive, to judge from a thermometer placed in another portion of it, could never have been less than 60 or 70 degrees. Did they sleep? So far as I could judge, and I have looked at them at all hours of the night as well as of the day, there were always some who were awake. The queen was always moving about amongst her daughters by night and day, but listlessly and without energy. She ceased to lay any eggs after the beginning of December. She re-commenced laying about a month or five weeks ago, slowly and at long intervals. She is now laying faster and faster, and in the height of the summer she will be laying between 2000 and 3000 eggs in the twenty-four hours.

As the summer advances, and as soon as the hives are teeming with a large and overflowing population, the bees have a natural tendency or instinct to swarm, teaching us what is the best remedy for a country like our own when it is overstocked and its inhabitants become too numerous for it. When the bees swarm, it is the reigning queen—the old queen as she is called—who goes forth with the swarm. Old she may be in comparison with the workers which live only from four to six months, according to the amount of work which they do, having a longer existence in winter than in summer, or with the drones which are destroyed at the end of each honey season. A queen will live from three to four years,

but she is not of much good in her fourth year. The use of moveable combed hives enables you to remove her at your pleasure when she gets too old.

Before the swarm leaves the hive with the queen, the bees take care to provide a successor. For this purpose they construct cells from two or four to twelve in number, of a peculiar shape, something like a large acorn hanging downwards, or a very small pear, and usually at the lower end of the combs. In this the queen-mother lays her ordinary egg, which after three days changes to a grub. This grub or larva the workers feed for five days with a peculiar food known as royal jelly. They then close the cell, and the larva spins its cocoon for twenty-four hours, passes through the pupa or nymph stage, and on the sixteenth day is developed into a perfectly-formed queen.

The queen you will see from the drawing which I hold in my hand is a different insect altogether from the worker-bee or the drone. She is made by one of those wonderful adaptations which we meet with so frequently in Nature, and which Paley made so much use of in his book on 'Natural Theology,' with a special reference to certain duties which she has to fulfil in life. Her wings are much shorter than those of the worker-bee or the drone, as she never uses them except on the rare occasions when she leaves the hive, viz. her one single marriage tour, which is never again repeated, or when she accompanies a swarm, and then she will fly as short a distance as her daughters will allow her to do. The queen has much larger and much stronger legs than the worker-bee, as she has perpetually to stride over the combs seeking empty cells in which to lay her eggs, resting the weight of her body upon them during that operation. Her abdomen is much longer than that of the worker-bee, as it has to be thrust down to the very bottom of the cells in order that the egg may adhere to the floor. The abdomen is also destitute of the means of secreting wax. Her sting is of a more curved form and one-third larger than that of a worker. She never uses it on a human being (though I have known a queen-bee *bite* a gentleman who put one in his mouth at one of the displays in our bee-tent) nor upon a worker or drone, but only upon a rival queen, or an unhatched princess. There is another very important distinction between a queen and a worker, which shows how Nature, or the God of Nature, has formed each inhabitant of the hive with a view to its peculiar functions. On the hinder legs of the worker-bees as they are returning to their hives you can see with the naked eye a little hollow or basket, which, as the spring arrives and they develop themselves, will be seen to be filled with yellow or green pellets, which the bee has collected with its front legs from the rest of its body, and thrust back to its hind legs. These pellets are the pollen from the flowers, about which I must say more hereafter. The pollen when mixed with a little honey is used as bee-bread for feeding the young brood. But it is not the province of the queen either to collect the pollen or to feed the brood. One other point I might notice in

enumerating the difference between the queen and the worker-bee. The queen is unable to feed herself. She has no long proboscis with which to suck the nectar from the flowers, but depends entirely upon the attentions of the workers. In the height of the egg-laying season she needs feeding every half hour or fifteen minutes. This is to my mind the reason why you always see the bees turning their faces to the queen in a hive, to be able to supply her wants the instant that she gives any intimation of a wish for food, also to be ready to attend to the egg the moment that it is laid, and therefore she has no pollen basket on her hinder legs. The queen has also her organs of reproduction fully developed so that she can fulfil all the offices of a mother. Such is the wonderful effect of the different food given by the bees to the occupant of the royal cell.

The process of rearing queens to meet some special emergency, such as the death of an existing queen, is even more wonderful than the one already described. If the bees have worker-eggs, or larvæ not more than three days old, they make one large cell out of three by nibbling away the partitions of two cells adjoining a third. They destroy the eggs or larvæ in two of these cells, and give the occupant of the other the royal jelly with which the queens are usually fed. They then enlarge the cell so as to give the grub ample space for its development, and as a security against failure they generally start a number of queen cells, although the work is not often continued upon all. Notice the difference in the capping of brood-cells and honey-cells, the latter air-tight, the former not, and the reasons for this. Bees will hatch out a queen from cells constructed and from eggs sealed up by other bees.

Let me tell you the history of the queen in my own observatory-hive. This is made to receive the frames of what is called a Woodbury hive, the first sort of the moveable combed hives which was known in England. It holds six combs, three on each side, one being placed above the other for the purpose of observation. This is of course not the natural manner in which the bees would build their combs; they would build them side by side, placing their brood in the middle, in order to economise the heat for hatching them out. Six frames were brought from a Woodbury hive in my garden and placed in the observatory-hive in my study. These unfortunately were taken from a queenless hive during my absence from home, and the combs themselves were more filled with honey, so as to look prettier than with brood. There was no young brood, in fact, from which the bees could make a queen. For some time the stock dwindled down, no bees being hatched, as there was no queen to lay fresh eggs. Upon my return home I soon ascertained the state of things, and caused a frame of comb from another hive with four sealed queen-cells upon it to be given to the diminishing remnant of bees which were still left. As soon as the comb was given to them, they seemed to take a new lease of life, collecting round two of the queen-cells and beginning to hatch out a queen. Before this could be done, however, before the six-

teenth day of the allotted term arrived, having a spare queen from the uniting of two weakish stocks, and having no immediate use for her, I placed her in the observatory-hive to see whether the bees would accept her as their sovereign instead of continuing to hatch out the queen-cell. I did not place her in a queen-cage, which is a little wire prison capable of being screwed on to the comb, in which the queen can remain in safety for a couple of days, whilst the bees make acquaintance with her by their power of smell and the touch of antennæ. My queen had no such protection, and the bees, instead of recognising her authority, and accepting her as their sovereign, drove her into one corner of the hive, surrounded her till she was lost to sight in the midst of a thick ball of bees, and suffocated or starved her to death. Her dead body was found at the bottom of the hive next morning. The bees then proceeded with the hatching out of one of the queens. The young queen produced found her way down a long glass-covered tunnel, by means of which my bees have access from the study to the open air, met some one favoured drone, was fertilised, found her way back through the window and up the tunnel, and soon commenced laying the eggs, which produced the present occupants of the hive, or, to speak more correctly, their elder sisters, for the first generation must have passed away.

All this took place at the end of July or beginning of August in last year. I therefore know exactly the age of my queen; a knowledge which, in practical bee-keeping, carried on with a view to profit, is of immense advantage to the bee-farmer. The age of every queen should be noted down in a book, or what is perhaps better, written on a tablet or a slate fastened in the roof or cover of a modern hive. It is not well to keep queens, if bee-keeping is to be profitable, after their third year. Some persons would say not after their second year.

The discovery of the fact that bees have the power of converting worker-eggs into queens, made, I believe, by a German clergyman named Schirach at the end of the last century, has caused quite a revolution in the art of bee-keeping. Instead of allowing his bees to swarm according to their liking, going away perhaps out of his reach and being lost to him for ever, or hanging in idle clusters for several days beforehand, the modern bee-keepers make what are called artificial swarms. That is to say, when the hive is full of bees and brood, when honey is abundant, and the weather warm, he removes from his bar-framed hive two or more combs abounding in brood and of course with the queen upon one of them. He places these frames in a fresh hive, which must be of the same dimensions as the old one, or the frames will be found not to fit it, and trouble will arise in various ways. He then removes the old hive from its stand, and places the fresh hive in its place. The bees returning from their foraging expeditions enter the accustomed opening, and though the appearance of the hive inside is somewhat changed from what it was when they last left, from there being so much fewer combs, still their queen is there and there is brood to

be hatched and fed, while the young bees are coming out of the cells, so they accommodate themselves to circumstances, and some begin building fresh combs to fill those frames of the hive which are as yet empty, and mere outlines on which work has to be done.

The use of artificial comb-production, a German invention adopted extensively by American bee-keepers, assists the bee greatly at this juncture, both in suggesting the building of the comb, and in helping them to build it in a straight line, so that the combs shall not run into one another, but be easily lifted and taken out of the hive for any future operations. The artificial swarm, if weather and other circumstances favour it, will be found to have filled their new frames with comb in about a week; sometimes in much less time. Mr. Cheshire mentioned, at a meeting at Great Berkhamstead, a case in which his bees had filled a hive with comb in 68 hours.

Let us now turn our attention for a moment to the parent hive from which the artificial swarm has been taken, and which has been removed as far as possible from its old stand. If it can be removed for three or four miles there is little chance of the old bees flying back to their old stand, but supposing this cannot be done, and that the bees can only be removed a few yards off, what is to be done then? There are three combs (let us say) removed from this old hive, but there are eight other combs left with brood in various stages of development in many of them (eleven combs in a hive is the usual number in modern bar-framed hives). It is best, before removing the old hive, to close up its entrance with perforated zinc, thus allowing full ventilation at the entrance of the hive. In every well-made hive, ventilation holes covered with perforated zinc will be found in the roof or cover. Imprison the old bees left in the old hive until the afternoon of the third day. Then remove the zinc from the entrance and let them fly back to their old position if they like. During the time of their imprisonment thousands of young bees will have been hatching, and these knowing no other home will all unite in the labours of the hive. The imprisoned bees must be supplied with water during the time of their durance vile to enable them to prepare food for the larvæ. Honey and bee-bread they will have in their combs in abundance at this time of the year; but there is no queen in the old hive now, and when the eggs which the old queen laid in its combs have hatched out, the increase of the population will come to a sudden end. Besides this, the bees will not work without a queen, and their stores will soon become the prey of robber-bees from other hives who will take advantage of their disorganised condition. How is this defect to be remedied? If the bee-master has chosen his time for artificially swarming judiciously, *i.e.* as nearly as possible to the time when natural swarming would have commenced (and by the use of a moveable comb hive he can easily ascertain from the state of his hive when this would be), the old or parent stock will contain a certain number of queen-cells in different stages of maturity. The appearance of these queen-cells

on the combs, and their relative approaches to maturity, will be in itself the best guide as to the right time for conducting his operations. If the artificial swarming took place a short time before the natural swarming would have taken place, one of these queens will soon be hatched out. The other cells can then be preserved for the use of other hives which it may be desirable to swarm a little before the natural time.

But now another consideration presents itself. The honey season in England and countries in the same latitude is very short (barely four months of the year, unless the bees can feed upon heather), and every day saved from inactivity and inaction is of great importance to the bee-keeper. After a young queen is hatched, some seven or eight days usually elapse before she goes forth on her wedding tour, and after that she is from a week to a fortnight before she begins laying the eggs, which, to produce worker-bees, take 21 days to hatch out. The number of bees will have decreased very much before any of the brood of the young queen makes its appearance. The skilful bee-master will therefore raise queens for himself, by a practical application of his knowledge that bees, under certain circumstances, will convert common eggs into queens, and will always have a queen ready, yes, and even a fertilised queen, to place in the old hive from which the artificial swarm has been taken, so that the work of egg-laying may begin at once and no time be unnecessarily wasted. The new queen must of course be imprisoned upon the combs in a queen-cage for 48 hours, or the bees may not accept her.

You will now understand how a knowledge of the nature and habits of bees influences their treatment and management. In a most admirable speech delivered by Prince Leopold at the Birkbeck Institute on Tuesday, February 25th, he endeavoured to impress upon his hearers that unskilled toil has no chance against knowledge. What chance, as regards bee-keeping, I might ask, has the English cottager with his straw skeps, his ignorance and prejudice, against the German peasant, who has been taught these principles of bee science from his youth up, in his national school, which no master is allowed to conduct without a certificate of proficiency in this respect? The bee to the German is what the pig is to the Irishman, he is the "gentleman as pays the rint," and so might the bee be to the English cottager, if its culture were only founded on a scientific basis.

There are two more points to which I have to call your attention, if I am not exhausting your patience. The first is the formation of the comb, in the cells of which the brood is hatched and the honey and pollen is stored up; and the second, the effect which the gathering of the pollen by the bee has upon the fertilisation of plants and flowers.

I spoke of the humble-bee as approaching very nearly to the ways of the honey-bee, but differing entirely in the formation of its nest, which is made in the ground and composed of a number of little cells heaped together in groups, without any attempt at

order or design. The wasp and the hornet, though they never attempt to winter in their nests as the honey-bee does, come nearer to this bee than any other insect in the structure of their habitations. The wasp, though she often builds her nest, as it is called, in the bank by the hedge side, will still often build it in the open, and the hornet usually chooses the branch of a tree or a beam in an out-house as an eligible building site. The difference of construction between the two buildings is, however, very great. The wasp builds her nest of paper, made from materials gathered from the outside world, by tearing off and masticating the fibres of rotten wood. The bee builds her nest of wax, which she produces from her own body. The process of building, and the architectural design, are altogether different. The wasp commences by fastening a short pillar of papier-maché to some root or branch. At the end of this pillar she makes a small cell, cup-shaped and opening downwards, and after a little while adds two others on each side. An egg is then laid by her in each cell, and she proceeds to make a roof over them of the shape of an umbrella. More cells are then made and more eggs laid. These are hatched. The larva grows rapidly through constant feeding, and the length of the cell walls has to be increased in proportion to the growth of their occupants. The grub spins a white silken cocoon over the mouth of its cell, passes through its transformation, and then bites its way out through the cell cover, its head having been downwards all the time. As the family increases, a new set of pillars is formed, and from these is suspended a second tier of cells. A third, fourth, and fifth follow as they are required, and as the nest is enlarged so is the outside paper cover enlarged in proportion.

Very differently does the honey-bee construct her cells. The combs built by the wasp lie horizontally one above another, and are made of paper or papier-maché. The combs of the bee are made of wax. This is secreted by the bee from the honey which it has sucked from the nectaries of the flowers, and is not gathered from the flowers themselves, as was formerly supposed before Huber and his successors made more accurate observation. Shakespeare himself fell into the error of mistaking the pollen, which the bees are seen carrying into the hives in the little baskets on their hind legs, for the wax with which they build their combs. In that scene in the play of King Henry the Fourth, where the Prince assumes the crown too hastily, the King likens "The foolish over-careful fathers, who have broke their sleep with thought, their brains with care, their bones with industry," in heaping up gold for their sons, to the bee which tolls from every flower the virtuous sweets, and which, with (as he says) thighs packed with wax and mouth with honey, brings its golden treasure to the hive, and then "is murdered for its pains." Shakespeare was wrong as to the bees carrying in the wax on their thighs. If he had examined a little more closely, he would have found it was pollen, which the bees brought in to make bee-bread for the young bees. But all good modern bee-keepers will, I am sure, agree with him in his

reprobation of that cruel, wasteful, and most barbarous way of taking honey, still practised by many (in spite of the efforts of our Bee Associations), which condemns the poor queen-bee with her hard-working daughters to a premature and violent death in the flames of the sulphur pit.

When the honey-bees are about to build a new comb, they hang in strings, holding each other by the feet, and they remain in that position a long time perfectly still. All this while they are evolving wax from the inner part of their abdomen. If you examine with a good magnifying glass the under side of the abdomen of worker-bees thus engaged, you will see six tiny white crescents, the edges of the wax plates, which are projecting from their wax pockets. With a little care you can detach one of these plates of wax, and place it under a microscope. When a sufficient quantity of wax has been obtained, the bee begins raising it to its mouth to knead it with the jaws—using them as a lathe, and mixing it with a frothy liquor from the tongue, and she continues to do so till she has made it quite soft and workable. She then begins those marvellous labours which have been the admiration and wonder of thoughtful men in all ages, and which caused Shakespeare to pay his tribute of admiration to the singing masons building roofs of gold. The bees have a great advantage in building horizontal cells in that they can begin with the roof first. They first construct a thin block of wax in the centre of the straw skep or of the middle frames in the modern moveable combed hive, measuring about half an inch in length and one sixth of an inch in height. Other bees are in waiting, and as soon as these can insert their bodies between the wax-workers, they commence operations on the rude block prepared for them. One bee excavates a shallow circular basin-like hole in one side of the block of wax, adding to the sides material which it has scraped out of the hollow. This is the first intimation of a cell. At the same time two other sculptor-bees are hard at work upon the other side of the block, excavating similar hollows, which are so contrived that the point where they meet exactly coincides with the centre of the first cell upon the opposite side. By building on this foundation and by adding to the edges, a double series of cells is built closely adjoining to one another, and with their entrances opening opposite ways.

But now a wonderful change in the form of the cells takes place. Up to this point the shape of the cells has been cylindrical. In this shape, however, they are to remain no longer. The bees know that such a construction would cause an unnecessary expenditure of wax, and wax is a precious substance with the bee. A bee eats and consumes about twenty pounds of honey in making one pound of wax. It would also decrease the available space of the hive and interfere with that perfect ventilation which the bees aim at obtaining before all other things. So by gradually cutting away all superfluous wax in the excavations first formed, the walls of the cells become straight, and the structure of the cell begins

to assume its hexagonal or six-sided form. Each cell is perfect in itself, and has six sides of its own, so that the side of one cell does not form a party wall to the cell adjoining, as it seems to do in this model which I hold in my hand, but each wall is spread upon the outside of the adjoining one. The cells have been separated in order to prove this curious fact. Every wall of each cell is varnished over with a thin layer of propolis. This is a gummy substance which the bees obtain from certain trees, more especially from the horse-chestnut. Every one must be familiar with the sticky substance that coats the buds of this tree, and guards them from the weather. Had it not been for this varnish of propolis, the separate walls would soon merge into one through the heat of the hive. Most living creatures make their nests in a circular form, most probably from their fixing themselves on their feet as a pivot, and working round them in a circle with their jaws. If the bees did not place so high a value on wax, their cells would probably be cylindrical also, but their economy as regards this precious substance leads them to scrape away as much as can be spared at the junction of the cells. If a cylinder be surrounded by other cylinders of equal diameter, six will exactly reach round it, and if the points of junction of the central cylinder were scooped away, the cylinder would become six-sided. The first set of cells which a bee makes upon the frame on the top of the skep are formed in this manner; they are circular at the commencement, and made hexagonal afterwards; but the bee, when once it has a hexagonal model on which to work, does not trouble itself to build cylinders and then cut away the angles, but fabricates hexagonal cells at once, only the first set being made on the cylindrical principle.

It will be interesting here, I think, to remind you of the wonderful testimony to the accuracy of mathematical science which has been borne by the work of the honey-bee. The base of each cell consists of three lozenge-shaped plates of wax. Many years ago, at the beginning of this century, Maraldi, the original inventor of a glass hive, being struck with the fact that these lozenge-shaped plates always had the same angles, took the trouble to measure them, and found that in each lozenge the large angles measured $109^{\circ} 28'$, and the smaller $70^{\circ} 32'$, the two together making 180° , the equivalent of two right angles. Some time afterwards, Reaumur, thinking that this remarkable uniformity of angle must have some connexion with that economy of space which is so striking a feature in the construction of the honey-comb, hit upon a very ingenious plan to ascertain whether his surmises were correct. Without mentioning his reasons for the question, he asked Kœnig, the mathematician, to make the following calculation:—"Given an hexagonal vessel terminated by three lozenge-shaped plates. What are the angles which would give the greatest amount of space with the least amount of material? Kœnig made his calculation and found that the large angles ought to be $109^{\circ} 26'$, and the smaller $70^{\circ} 34'$, together 180° , being a difference of only two minutes less

in the larger angles, and two minutes more in the smaller, than Maraldi had found his original measurement of the plates to be. Reaumur thought that the bee had come quite near enough in the solution of the mathematical problem, and mathematicians generally were delighted with the result of the investigation. Maclaurin, however, a well-known Scotch mathematician, was not so easily satisfied. The two results very nearly tallied with each other, but not quite, and he felt that in a mathematical question precision was a necessity. He tried the whole question himself, and found that Maraldi's measurements of the lozenge-shaped plates were quite correct, $109^{\circ} 28'$ for large angles, and $70^{\circ} 32'$ for smaller angles. He then set to work upon the problem which Reaumur had given to Kœnig, and found to his great delight that Kœnig must have been wrong, as the true theoretical angles were $109^{\circ} 28'$ and $70^{\circ} 32'$, precisely corresponding with the actual measurements of the bee cell. Another question now arose—how could this good man have gone wrong—how could so excellent a mathematician as Kœnig have made so great a mistake? Bad workers generally complain of their tools without reason, but here was a case in which a good workman had to complain of his tools with reason. On investigation it was found that no blame attached to Kœnig himself, but that there was an error in the book of logarithms which he had used. So a mistake in a mathematical work was corrected by a little honey-bee working out its cell; and as captains of ships would have gone on calculating their longitudes by these same faulty tables of logarithms, if the mistake had not been discovered, the bee may be said to have saved the life of many a gallant ship, and perhaps the life of many a gallant seaman.

But we must spend no more time on the habitation of the bee. She uses the cells of the comb, thus fearfully and wonderfully made, as the cradles for the grubs developed from the eggs which the queen lays in them, and for the storage of honey and pollen. The honey is intended (1) for the feeding of the queen, who takes her food from the mouths of the attendants that are always waiting upon her, never turning their tails, in order that they may be ready to satisfy the wants of their mother; (2) for the feeding of those bees who are working at home; (3) for the feeding of the young brood; (4) for the use of the family during the winter until the spring brings the flowers again. It has been said that some English bees transported to countries near the Equator, where there is a perpetual summer, found out after a year or two that there was no winter to be provided for, and so gave up storing honey and making any provision for it. The pollen is used, as you have heard, for feeding the grub and the young bees. In collecting the pollen the bees afford another and a most striking proof of the marvellous adaptation of one portion of creation to another. It is not my business to-night to discuss the question of primary or secondary laws. Any one who has read Mr. Charles Darwin's most interesting work upon the various contrivances by which British and foreign orchids are fertilised by insects, will remember his conviction—a

conviction founded on long and most accurate study—that Nature in the most emphatic manner tells us, in plants and flowers, as well as in live stock, that she abhors perpetual self-fertilisation. Throughout the great family of orchids, including 432 genera and probably 6,000 species, the act of fertilisation by the conveying of the pollen from the anther of the male organ to the stigma of the female is almost universally left to insects. In this work of fertilisation the bee takes his share amongst other insects, and more than his share, for in some cases the bee is indispensable for the fertilisation of plants.

In New Zealand, before the introduction of the bee, the clover would not seed. The common red clover, according to Mr. Darwin's observations, is visited by the humble-bee alone, its greater length of proboscis enabling it alone to probe the depths of the tubes of its corolla. The same author mentions in his 'Origin of Species' that he has repeatedly seen, but only in the autumn, many hive-bees sucking the flowers through holes which have been bitten in the base of the tube by humble-bees. It is asserted that when the red clover has been mown, the flowers of the second crop are somewhat smaller, and these are visited by the hive-bees. The Ligurian bee is said to be able to reach and suck the nectar of the clover. In the 'Bee Journal' of March 1st, 1877—and let me recommend this journal to all who wish for information on bees and bee-keeping—I find a letter from Mr. Darwin transcribed from the 'Gardeners' Chronicle,' in which he calls attention to the scarcity of holly-berries throughout the country generally in the early part of that year, adding that he had received several letters from correspondents, asking him if he could account for the failure of the seed-crop of clover, although the clover plants themselves looked vigorous and healthy. The holly, Mr. Darwin remarks, is a dioecious plant. During forty years in which he had closely observed its flowers, he had never found an hermaphrodite. Bees, he says, are the chief transporters of pollen from the male to the female tree, and the latter will produce few berries if bees are scarce. He mentions a case in which he watched the fertilisation of a female tree, sixty yards distant from the nearest male tree, during a period of days in which the wind had invariably set from the female towards the male tree, and in which, therefore, the pollen from the male tree could not have been conveyed to the female by the wind, but must have been carried by the bees. He concludes his letter by saying that he believes the reason why English people could not decorate their homes with the scarlet berries of the holly for the Christmas of 1876 was because bees were so rare in the spring of that year; and Mr. Abbott, the editor of the 'Bee Journal,' clenches his remarks and confirms his belief by reminding his readers how unpropitious for bees was the summer of 1875. The breeding of bees at the close of that summer had ceased some months before they became inactive, and as a consequence many stocks of bees had become individually too aged to withstand the winter and to furnish the requisite supply of

young bees in the spring. Thousands of colonies, Mr. Abbott says, perished from this cause, and in some parts whole districts were depopulated.

The spring of 1879 seems to be as unpropitious for bees and bee-keepers, as far as weather is concerned, as that of 1875. But as far as my own experience goes, bees, where they have been properly attended to, have survived the winter well. Many stocks have, to my knowledge, perished, but their fate is (in nearly every case) attributable to the incompetency or inattention of their owners. To go back to the starting point of my lecture and the dictum of the judge in the Metropolitan County Court, these people ought not to have attempted to keep bees until they had learnt their needs and requirements.

A great advance has been made in bee-keeping through the exertions of the British Bee-keepers' Association, and the county and local societies which have emanated from it. Bees have been treated much more humanely and much more intelligently and carefully than before. I have not time to-night to speak to you of the objects or mode of working of these associations. I have not ventured to touch upon to-night, "The Principles Involved in Profitable Bee-Culture," but I hope that all those members of the Society who keep bees will learn in course of time how to make their £3 per hive, which Mr. Cheshire has mentioned as being the average rate of profit which every intelligent bee-keeper may expect to reap from the labour of his bees.

27.—REDUCTION OF METEOROLOGICAL OBSERVATIONS.

By WILLIAM MARRIOTT, F.M.S.

Communicated by J. HOPKINSON, Hon. Sec.

[Read 13th May, 1879.]

HAVING on a former occasion read a paper before this Society entitled "Instructions for taking Meteorological Observations,"* I have now the pleasure of supplementing it, at the request of your Secretary, by another on the "Reduction of Meteorological Observations."

The readings of nearly all meteorological instruments require some correction to give true results. The object of the "reduction" is to eliminate the instrumental and other errors, so that the readings may be comparable with those made at other places, and also to deduce further results from the observations.

As it is hardly possible to manufacture the instruments absolutely perfect, it is necessary that they should be compared with a recognised standard. The Kew Observatory possesses such standards, and has a special department for the verification of meteorological instruments. A moderate charge is made for the comparison and a certificate given of the corrections to be applied. It is *essential* that all the instruments employed be sent to Kew for verification before being used, so that the proper corrections to be applied to their readings may be known. As mercurial thermometers are liable through age to read too high, it is desirable that they be re-verified after the space of two or three years.

These corrections may, no doubt, appear to some to be very trivial matters and not worth taking notice of; this may be so for very *rough* purposes: but if the observations are made for scientific purposes, and are to have any pretence to accuracy, so as to be comparable with those at other places, then it is important that the corrections should be duly applied, otherwise the deductions drawn from the readings may be misleading and erroneous. For instance, suppose the dry-bulb thermometer to have a correction of $+0^{\circ}\cdot5$, and the wet-bulb $-0^{\circ}\cdot5$, and the readings to be $50^{\circ}\cdot0$ and $46^{\circ}\cdot0$; the calculated dew-point for the latter would be $41^{\circ}\cdot8$, and the relative humidity 74; but if the proper corrections were applied, the readings would then be: dry-bulb $50^{\circ}\cdot5$, wet-bulb $45^{\circ}\cdot5$, dew-point $40^{\circ}\cdot2$, relative humidity 68.

BAROMETER.—There are three corrections to be applied to the readings of the barometer, viz. for (1) index error, (2) temperature, and (3) height above sea-level.

(1). The correction for index error is that given on the Kew certificate; if the barometer be a Fortin, the correction will be the same throughout the scale: but if of the Kew pattern, it will most likely be variable. As the corrections are only given for every

* 'Transactions,' Vol. I, p. 211.

half-inch between 27·5 ins. and 31·0 ins., it will be necessary in the latter case to interpolate for intermediate readings. Suppose the corrections to be

ins.	ins.	ins.	ins.	ins.	ins.	ins.	ins.
27·5	28·0	28·5	29·0	29·5	30·0	30·5	31·0
—·010	—·009	—·008	—·007	—·006	—·005	—·004	—·003

they should be interpolated as follows:—

ins.		ins.		ins.		ins.	
27·50	} —·010	27·75	} —·009	28·25	} —·008	28·75	} —·007
to		to		to		to	
27·75		28·25		28·75		29·25	
29·25	} —·006	29·75	} —·005	30·25	} —·004	30·75	} —·003
to		to		to		to	
29·75		30·25		30·75		31·00	

TABLE I.—*Corrections for Reducing Observations of the Barometer to 32°.*

Attached Thermometer.	in. 28·5	in. 29·0	in. 29·5	in. 30·0	in. 30·5	Attached Thermometer.	in. 28·5	in. 29·0	in. 29·5	in. 30·0	in. 30·5
30°	in. —·004	in. —·004	in. —·004	in. —·004	in. —·004	55°	in. —·068	in. —·069	in. —·070	in. —·071	in. —·072
31	—·006	—·007	—·007	—·007	—·007	56	—·070	—·071	—·073	—·074	—·075
32	—·009	—·009	—·009	—·009	—·010	57	—·073	—·074	—·075	—·076	—·078
33	—·012	—·012	—·012	—·012	—·012	58	—·075	—·077	—·078	—·079	—·081
34	—·014	—·014	—·015	—·015	—·015	59	—·078	—·079	—·080	—·082	—·083
35	—·017	—·017	—·017	—·018	—·018	60	—·080	—·082	—·083	—·085	—·086
36	—·019	—·020	—·020	—·020	—·021	61	—·083	—·084	—·086	—·087	—·089
37	—·022	—·022	—·022	—·023	—·023	62	—·085	—·087	—·088	—·090	—·091
38	—·024	—·025	—·025	—·026	—·026	63	—·088	—·089	—·091	—·093	—·094
39	—·027	—·027	—·028	—·028	—·029	64	—·090	—·092	—·094	—·095	—·097
40	—·029	—·030	—·030	—·031	—·031	65	—·093	—·095	—·096	—·098	—·100
41	—·032	—·033	—·033	—·034	—·034	66	—·096	—·097	—·099	—·101	—·102
42	—·034	—·035	—·036	—·036	—·037	67	—·098	—·100	—·102	—·103	—·105
43	—·037	—·038	—·038	—·039	—·040	68	—·101	—·102	—·104	—·106	—·108
44	—·040	—·040	—·041	—·042	—·042	69	—·103	—·105	—·107	—·109	—·110
45	—·042	—·043	—·044	—·044	—·045	70	—·106	—·108	—·109	—·111	—·113
46	—·045	—·045	—·046	—·047	—·048	71	—·108	—·110	—·112	—·114	—·116
47	—·047	—·048	—·049	—·050	—·051	72	—·111	—·113	—·115	—·117	—·119
48	—·050	—·051	—·052	—·052	—·053	73	—·113	—·115	—·117	—·119	—·121
49	—·052	—·053	—·054	—·055	—·056	74	—·116	—·118	—·120	—·122	—·124
50	—·055	—·056	—·057	—·058	—·059	75	—·118	—·120	—·122	—·125	—·127
51	—·057	—·058	—·059	—·060	—·061	76	—·121	—·123	—·125	—·127	—·129
52	—·060	—·061	—·062	—·063	—·064	77	—·123	—·126	—·128	—·130	—·132
53	—·063	—·064	—·065	—·066	—·067	78	—·126	—·128	—·130	—·133	—·135
54	—·065	—·066	—·067	—·068	—·070	79	—·128	—·131	—·133	—·135	—·137

(2). The correction for temperature is to be next applied to reduce the readings to a fixed temperature, viz. 32°. Table I.* gives these corrections for every half-inch, from 28·5 ins. to 30·5 ins., and for each degree of the attached thermometer from 30° to 79°. In using the table, first find the temperature in the left-hand column corresponding to that of the attached thermometer, then run the eye along the horizontal line to the column corresponding to that of the reading of the barometer, and the value there found is the correction required. Example: Barometer reading 29·500 ins., attached thermometer 40°. On the line opposite to 40° and under 29·5 ins., is the correction —·030 in. If the attached thermometer or barometer readings be intermediate between those given in the table, the corrections can easily be found by interpolation.

TABLE II.—*Corrections for Reducing Observations of the Barometer to Sea-level.*

Feet.	Bar. at Sea-level, 28·0 in.				Bar. at Sea-level, 29·0 in.				Bar. at Sea-level, 30·0 in.			
	20°	40°	60°	80°	20°	40°	60°	80°	20°	40°	60°	80°
	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.
20	+.022	+.021	+.020	+.019	+.023	+.022	+.021	+.020	+.023	+.023	+.022	+.021
40	.044	.042	.040	.038	.045	.044	.041	.049	.047	.045	.043	.041
60	.066	.063	.060	.058	.068	.066	.062	.060	.070	.068	.065	.062
80	.088	.084	.080	.076	.091	.087	.083	.079	.094	.090	.086	.082
100	.109	.105	.100	.096	.113	.108	.104	.100	.117	.112	.108	.103
120	.131	.126	.120	.116	.136	.130	.124	.120	.140	.134	.129	.124
140	.153	.147	.141	.134	.159	.152	.146	.139	.164	.157	.151	.144
160	.175	.168	.160	.154	.181	.173	.166	.159	.187	.179	.172	.165
180	.197	.189	.181	.173	.204	.195	.187	.179	.211	.202	.194	.185
200	.219	.210	.201	.192	.226	.217	.208	.199	.234	.224	.215	.206
220	.241	.230	.220	.211	.249	.238	.228	.219	.257	.246	.236	.227
240	.263	.251	.240	.231	.272	.260	.249	.239	.281	.269	.258	.248
260	.284	.272	.261	.250	.294	.281	.270	.259	.304	.291	.279	.268
280	.306	.293	.281	.269	.317	.303	.291	.278	.328	.314	.301	.288
300	.328	.314	.300	.288	.339	.325	.311	.298	.351	.336	.322	.309
320	.350	.334	.320	.307	.362	.346	.331	.318	.374	.358	.343	.329
340	.371	.355	.340	.326	.384	.367	.352	.338	.397	.380	.365	.350
360	.393	.376	.360	.345	.407	.389	.373	.358	.421	.403	.386	.370
380	.414	.396	.380	.365	.429	.410	.394	.378	.444	.425	.408	.391
400	.435	.417	.400	.383	.451	.432	.414	.397	.467	.447	.429	.411
420	.457	.437	.420	.402	.473	.453	.435	.417	.490	.469	.450	.431
440	.479	.458	.439	.422	.496	.474	.455	.437	.513	.491	.471	.452
460	.500	.479	.459	.440	.518	.496	.476	.456	.537	.514	.493	.472
480	.522	.500	.479	.460	.541	.518	.496	.476	.560	.536	.514	.493
500	.543	.520	.499	.479	.563	.539	.517	.496	.583	.558	.535	.513

* Tables I. and II. have been compiled from tables in 'Instructions in the Use of Meteorological Instruments.' By Robert H. Scott, M.A., F.R.S. London, 1875.

(3). The correction for height above sea-level varies not only with the altitude, but also with the temperature and pressure of the air. Table II. gives the corrections for reducing the barometer readings to sea-level for every 20 feet up to 500 feet, for the air temperatures of 20°, 40°, 60°, and 80°, at the *sea-level pressures* of 28·0 ins., 29·0 ins., and 30·0 ins. From this table should be prepared another one for the height of the particular station for which it is to be used, giving the corrections for altitude for every tenth of an

TABLE III.—*For Reducing Observations of the Barometer to Sea-level.*

STATION 240 FEET.

Sea-level Pressure.	Temperature of Air (<i>i.e.</i> Dry-bulb).							Reading of Barometer at 240 feet.
	20°	30°	40°	50°	60°	70°	80°	
ins.	in.	in.	in.	in.	in.	in.	in.	ins.
30·6	+·286	+·280	+·274	+·269	+·263	+·257	+·253	30·3
·5	·285	·279	·273	·268	·262	·256	·252	·2
·4	·285	·279	·273	·268	·262	·256	·252	·1
·3	·284	·278	·272	·267	·261	·255	·251	30·0
·2	·283	·277	·271	·266	·260	·254	·250	29·9
·1	·282	·276	·270	·265	·259	·253	·249	·8
30·0	·281	·275	·269	·264	·258	·252	·248	·7
29·9	·280	·274	·268	·263	·257	·251	·247	·6
·8	·279	·273	·267	·262	·256	·250	·246	·5
·7	·278	·272	·266	·261	·255	·249	·245	·4
·6	·277	·271	·265	·260	·254	·248	·244	·3
·5	·276	·270	·264	·259	·253	·247	·243	·2
·4	·276	·270	·264	·259	·253	·247	·243	·1
·3	·275	·269	·263	·258	·252	·246	·242	29·0
·2	·274	·268	·262	·257	·251	·245	·241	28·9
·1	·273	·267	·261	·256	·250	·244	·240	·8
29·0	·272	·266	·260	·255	·249	·243	·239	·7
28·9	·271	·265	·259	·254	·248	·242	·238	·6
·8	·270	·264	·258	·253	·247	·241	·237	·5
·7	·269	·263	·257	·252	·246	·240	·236	·4
·6	·268	·262	·256	·251	·245	·239	·235	·3
28·5	·267	·261	·255	·250	·244	·238	·234	28·2

inch pressure from 28·5 ins. to 30·6 ins., and each 10° of temperature from 20° to 80°. Table III. is a specimen of this form for 240 feet, the height of Watford. This table is prepared in the following manner: the form having been ruled, and the temperatures at the top and the sea-level pressures in the left-hand column having been filled in, the corrections for 240 feet, at 29·0 ins. and 30·0 ins., are copied from Table II., and entered on the lines representing these values; the intermediate readings are then filled up by interpolation. When this has been done, it will be seen

what is the average correction,—in the present case it is $\cdot 26$; this might be called $\cdot 3$; and by deducting $\cdot 3$ from all the values in the left-hand column, and entering the results in the right-hand column, the reading at the station corresponding to that at the sea-level will be approximately obtained. This is the column to be used for ascertaining the correction to be applied to the barometer reading to reduce it to sea-level.

The following example will show the method of applying the foregoing corrections. Suppose the readings to be :

Attached thermometer.	Barometer.	Dry-bulb.	Correction for index error.		
55°	29·526 ins.	53°	—·005 in.		
then					ins.
Barometer reading	...	...	...	...	29·526
(1) Correction for index error			...	...	—·005
					<hr/> 29·521
(2) ,, temperature 55° (Table I.)			...	...	—·070
					<hr/> 29·451
(3) ,, altitude (Table III.)			...	...	+·259
					<hr/> 29·710
Barometer reading at sea-level			...	...	<hr/>29·710

As the application of these several corrections takes some time, I have devised a form of table for combining all three (when that for index error is the same throughout the scale), which is the means of saving much time and labour, besides greatly reducing the liability to mistake. It will be seen in Table III. that a change of 0·6 in. in the pressure produces the same amount of variation in the correction for altitude as is produced by an alteration of 10° in the temperature of the air. For instance, the correction for altitude, when the pressure is at 30·0 ins., at the temperature 60°, is the same as that when the pressure is 29·4 ins. and the temperature 50°. By taking a mean height of the barometer, we can combine the correction for temperature with that for altitude; and when the index error is constant (as in the Fortin barometer), it can also be included. Table IV. is a specimen of this form, made out for each $\cdot 06$ in. of barometer reading from 28·68 ins. to 30·18 ins. and every 2° of temperature of the dry-bulb and attached thermometers, for a station 240 feet above sea-level. To use the table: Look in the column on the right or left in the upper portion of the table, for the reading of the barometer at the station, and carry the eye horizontally to the temperature of the air (*i.e.* dry-bulb reading), and then vertically downwards, and through the corresponding column in the second half of the table, until the value horizontally opposite the temperature of the attached thermometer is the required correction.

THERMOMETERS.—The corrections for the various thermometers (dry, wet, max., min., etc.) are given on the Kew certificate for every 10°, and will most likely vary throughout their scales. They

TABLE IV.—Combined Correction for Temperature and Altitude.—WATFORD, 240 feet.

Baro- meter Reading.	Temperature of the Air (i.e. Dry-bulb Reading).																				Baro- meter Reading.
	Inch.	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°	Inch.
30.18	46	48	50	52	54	56	58	60	62	64	66	68	70	72	74	76	78	80	82	84	30.18
30.12	45	47	49	51	53	55	57	59	61	63	65	67	69	71	73	75	77	79	81	83	30.12
30.06	44	46	48	50	52	54	56	58	60	62	64	66	68	70	72	74	76	78	80	82	30.06
30.00	43	45	47	49	51	53	55	57	59	61	63	65	67	69	71	73	75	77	79	81	30.00
29.94	42	44	46	48	50	52	54	56	58	60	62	64	66	68	70	72	74	76	78	80	29.94
29.88	41	43	45	47	49	51	53	55	57	59	61	63	65	67	69	71	73	75	77	79	29.88
29.82	40	42	44	46	48	50	52	54	56	58	60	62	64	66	68	70	72	74	76	78	29.82
29.76	39	41	43	45	47	49	51	53	55	57	59	61	63	65	67	69	71	73	75	77	29.76
29.70	38	40	42	44	46	48	50	52	54	56	58	60	62	64	66	68	70	72	74	76	29.70
29.64	37	39	41	43	45	47	49	51	53	55	57	59	61	63	65	67	69	71	73	75	29.64
29.58	36	38	40	42	44	46	48	50	52	54	56	58	60	62	64	66	68	70	72	74	29.58
29.52	35	37	39	41	43	45	47	49	51	53	55	57	59	61	63	65	67	69	71	73	29.52
29.46	34	36	38	40	42	44	46	48	50	52	54	56	58	60	62	64	66	68	70	72	29.46
29.40	33	35	37	39	41	43	45	47	49	51	53	55	57	59	61	63	65	67	69	71	29.40
29.34	32	34	36	38	40	42	44	46	48	50	52	54	56	58	60	62	64	66	68	70	29.34
29.28	31	33	35	37	39	41	43	45	47	49	51	53	55	57	59	61	63	65	67	69	29.28
29.22	30	32	34	36	38	40	42	44	46	48	50	52	54	56	58	60	62	64	66	68	29.22
29.16	29	31	33	35	37	39	41	43	45	47	49	51	53	55	57	59	61	63	65	67	29.16
29.10	28	30	32	34	36	38	40	42	44	46	48	50	52	54	56	58	60	62	64	66	29.10
29.04	27	29	31	33	35	37	39	41	43	45	47	49	51	53	55	57	59	61	63	65	29.04
28.98	26	28	30	32	34	36	38	40	42	44	46	48	50	52	54	56	58	60	62	64	28.98
28.92	25	27	29	31	33	35	37	39	41	43	45	47	49	51	53	55	57	59	61	63	28.92
28.86	24	26	28	30	32	34	36	38	40	42	44	46	48	50	52	54	56	58	60	62	28.86
28.80	23	25	27	29	31	33	35	37	39	41	43	45	47	49	51	53	55	57	59	61	28.80
28.74	22	24	26	28	30	32	34	36	38	40	42	44	46	48	50	52	54	56	58	60	28.74
28.68	21	23	25	27	29	31	33	35	37	39	41	43	45	47	49	51	53	55	57	59	28.68

Correction to be added to the Reading of the Barometer.

Attached thermo- meter.																					Attached thermo- meter.
	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	
30°	'268	'267	'266	'265	'263	'262	'261	'260	'259	'257	'256	'255	'254	'253	'251	'250	'249	'248	'247	'246	in.
32	'263	'262	'261	'260	'258	'257	'256	'255	'254	'252	'251	'250	'249	'248	'246	'245	'244	'243	'242	'241	in.
34	'257	'256	'255	'254	'252	'251	'250	'249	'248	'246	'245	'244	'243	'242	'240	'239	'238	'237	'236	'235	in.
36	'252	'251	'250	'249	'247	'246	'245	'244	'243	'241	'240	'239	'238	'237	'235	'234	'233	'232	'231	'230	in.
38	'247	'246	'245	'244	'242	'241	'240	'239	'238	'236	'235	'234	'233	'232	'230	'229	'228	'227	'226	'225	in.
40	'242	'241	'240	'239	'237	'236	'235	'234	'233	'231	'230	'229	'228	'227	'225	'224	'223	'222	'221	'220	in.
42	'236	'235	'234	'233	'231	'230	'229	'228	'227	'225	'224	'223	'222	'221	'219	'218	'217	'216	'215	'214	in.
44	'231	'230	'229	'228	'226	'225	'224	'223	'222	'220	'219	'218	'217	'216	'214	'213	'212	'211	'210	'209	in.
46	'226	'225	'224	'223	'221	'220	'219	'218	'217	'215	'214	'213	'212	'211	'209	'208	'207	'206	'205	'204	in.
48	'220	'219	'218	'217	'215	'214	'213	'212	'211	'209	'208	'207	'206	'205	'203	'202	'201	'200	'199	'198	in.
50	'215	'214	'213	'212	'210	'209	'208	'207	'206	'204	'203	'202	'201	'200	'198	'197	'196	'195	'194	'193	in.
52	'210	'209	'208	'207	'205	'204	'203	'202	'201	'199	'198	'197	'196	'195	'193	'192	'191	'190	'189	'188	in.
54	'205	'204	'203	'202	'200	'199	'198	'197	'196	'194	'193	'192	'191	'190	'188	'187	'186	'185	'184	'183	in.
56	'199	'198	'197	'196	'194	'193	'192	'191	'190	'188	'187	'186	'185	'184	'182	'181	'180	'179	'178	'177	in.
58	'194	'193	'192	'191	'189	'188	'187	'186	'185	'183	'182	'181	'180	'179	'177	'176	'175	'174	'173	'172	in.
60	'189	'188	'187	'186	'184	'183	'182	'181	'180	'178	'177	'176	'175	'174	'172	'171	'170	'169	'168	'167	in.
62	'184	'183	'182	'181	'179	'178	'177	'176	'175	'173	'172	'171	'170	'169	'167	'166	'165	'164	'163	'162	in.
64	'178	'177	'176	'175	'173	'172	'171	'170	'169	'167	'166	'165	'164	'163	'161	'160	'159	'158	'157	'156	in.
66	'173	'172	'171	'170	'168	'167	'166	'165	'164	'162	'161	'160	'159	'158	'156	'155	'154	'153	'152	'151	in.
68	'168	'167	'166	'165	'163	'162	'161	'160	'159	'157	'156	'155	'154	'153	'151	'150	'149	'148	'147	'146	in.
70	'163	'162	'161	'160	'158	'157	'156	'155	'154	'152	'151	'150	'149	'148	'146	'145	'144	'143	'142	'141	in.
72	'157	'156	'155	'154	'152	'151	'150	'149	'148	'146	'145	'144	'143	'142	'140	'139	'138	'137	'136	'135	in.
74	'152	'151	'150	'149	'147	'146	'145	'144	'143	'141	'140	'139	'138	'137	'135	'134	'133	'132	'131	'130	in.
76	'147	'146	'145	'144	'142	'141	'140	'139	'138	'136	'135	'134	'133	'132	'130	'129	'128	'127	'126	'125	in.
78	'142	'141	'140	'139	'137	'136	'135	'134	'133	'131	'130	'129	'128	'127	'125	'124	'123	'122	'121	'120	in.
80	'137	'136	'135	'134	'132	'131	'130	'129	'128	'126	'125	'124	'123	'122	'120	'119	'118	'117	'116	'115	in.

therefore require to be distributed through the intermediate degrees.
Example: Suppose the corrections to be at

32°	42°	52°	62°	72°	82°	92°
−0.2	−0.2	−0.1	−0.1	−0.2	−0.3	−0.3

they should be distributed as follows:

32° to 47	} −0.2	47° to 67	} −0.1	67° to 77	} −0.2	77° and above	} −0.3
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From the readings of the dry- and wet-bulb thermometers can be deduced the temperature of the dew-point, the elastic force of aqueous vapour, and the relative humidity. Glaisher's 'Hygrometrical Tables' * are those in general use in this country for making these deductions, and they should be in the possession of the observer for reference.

I have devised a table,† based on Glaisher's factors, by which the dew-point can be quickly calculated at inspection from the readings of the dry- and wet-bulb thermometers (see Table V.). It is intended only for such readings as are ordinarily observed in this country, viz. between 30° and 79°.

The arrangement of the Table is as follows:—The first column on the left gives the reading of the dry-bulb thermometer for every degree from 30° to 79°. The other columns give, for each degree of difference between the readings of the dry- and wet-bulb thermometers, the amount to be subtracted from the reading of the wet-bulb thermometer to obtain the temperature of the dew-point. The amounts for tenths of degrees can of course be at once obtained by merely shifting the decimal point one place to the left.

The following examples will show the manner of using the Table:—

- (1). Suppose the reading of the dry-bulb thermometer °
to be 50.0
And the reading of the wet-bulb thermometer to be 45.0
The difference is 5.0

On looking at the Table, we find the amount to be subtracted
from the reading of the wet-bulb thermometer is ... 5.3
Therefore the dew-point is, 45.0 − 5.3 39.7

- (2). Suppose the reading of the dry-bulb thermometer
to be 55.5
And the reading of the wet-bulb thermometer to be 48.3
The difference is 7.2

On referring to the Table, we see the amount to be subtracted for 7.0=6.7, and for 0.2=0.19, say 0.2, giving 6.9 as the total amount to be subtracted from the reading of the wet-bulb thermometer.
Therefore the dew-point is, 48.3−6.9 41.4

* 'Hygrometrical Tables adapted to the Use of the Dry- and Wet-bulb Thermometer.' By James Glaisher, F.R.S. Fifth edition. London, 1869.
† 'Table for facilitating the determination of the Dew-point from observations of the Dry- and Wet-Bulb Thermometers.' London, 1874.

TABLE V.—For Calculating the Dew-point.

Reading of Dry-bulb.	Difference between Dry- and Wet-bulb Thermometers.														
	1°	2°	3°	4°	5°	6°	7°	8°	9°	10°	11°	12°	13°	14°	15°
	Amount to be subtracted from the Wet-bulb reading to obtain the Dew-point.														
30	3.2	6.3	9.5	12.6	15.8	18.9	22.1	25.2	28.4	31.5	34.7	37.8	41.0	44.1	47.3
31	2.7	5.4	8.1	10.8	13.5	16.2	18.9	21.6	24.3	27.0	29.7	32.4	35.1	37.8	40.5
32	2.3	4.6	7.0	9.3	11.6	13.9	16.2	18.6	20.9	23.2	25.5	27.8	30.2	32.5	34.8
33	2.0	4.0	6.0	8.0	10.0	12.1	14.1	16.1	18.1	20.1	22.1	24.1	26.1	28.1	30.2
34	1.8	3.5	5.3	7.1	8.9	10.6	12.4	14.2	15.9	17.7	19.5	21.2	23.0	24.8	26.6
35	1.6	3.2	4.8	6.4	8.0	9.6	11.2	12.8	14.4	16.0	17.6	19.2	20.8	22.4	24.0
36	1.5	3.0	4.5	6.0	7.5	9.0	10.5	12.0	13.5	15.0	16.5	18.0	19.5	21.0	22.5
37	1.4	2.8	4.3	5.7	7.1	8.5	9.9	11.4	12.8	14.2	15.6	17.0	18.5	19.9	21.3
38	1.4	2.7	4.1	5.4	6.8	8.2	9.5	10.9	12.2	13.6	15.0	16.3	17.7	19.0	20.4
39	1.3	2.6	4.0	5.3	6.6	7.9	9.2	10.6	11.9	13.2	14.5	15.8	17.2	18.5	19.8
40	1.3	2.6	3.9	5.2	6.5	7.7	9.0	10.3	11.6	12.9	14.2	15.5	16.8	18.1	19.4
41	1.3	2.5	3.8	5.0	6.3	7.6	8.8	10.1	11.3	12.6	13.9	15.1	16.4	17.6	18.9
42	1.2	2.5	3.7	4.9	6.2	7.4	8.6	9.8	11.1	12.3	13.5	14.8	16.0	17.2	18.5
43	1.2	2.4	3.6	4.8	6.0	7.2	8.4	9.6	10.8	12.0	13.2	14.4	15.6	16.8	18.0
44	1.2	2.4	3.5	4.7	5.9	7.1	8.3	9.4	10.6	11.8	13.0	14.2	15.3	16.5	17.7
45	1.2	2.3	3.5	4.6	5.8	7.0	8.1	9.3	10.4	11.6	12.8	13.9	15.1	16.2	17.4
46	1.1	2.3	3.4	4.6	5.7	6.8	8.0	9.1	10.3	11.4	12.5	13.7	14.8	16.0	17.1
47	1.1	2.2	3.4	4.5	5.6	6.7	7.8	9.0	10.1	11.2	12.3	13.4	14.6	15.7	16.8
48	1.1	2.2	3.3	4.4	5.5	6.6	7.7	8.8	9.9	11.0	12.1	13.2	14.3	15.4	16.5
49	1.1	2.2	3.2	4.3	5.4	6.5	7.6	8.6	9.7	10.8	11.9	13.0	14.0	15.1	16.2
50	1.1	2.1	3.2	4.2	5.3	6.4	7.4	8.5	9.5	10.6	11.7	12.7	13.8	14.8	15.9
51	1.0	2.1	3.1	4.2	5.2	6.2	7.3	8.3	9.4	10.4	11.4	12.5	13.5	14.6	15.6
52	1.0	2.0	3.1	4.1	5.1	6.1	7.1	8.2	9.2	10.2	11.2	12.2	13.3	14.3	15.3
53	1.0	2.0	3.0	4.0	5.0	6.0	7.0	8.0	9.0	10.0	11.0	12.0	13.0	14.0	15.0
54	1.0	2.0	2.9	3.9	4.9	5.9	6.9	7.8	8.8	9.8	10.8	11.8	12.7	13.7	14.7
55	1.0	1.9	2.9	3.8	4.8	5.8	6.7	7.7	8.6	9.6	10.6	11.5	12.5	13.4	14.4
56	0.9	1.9	2.8	3.8	4.7	5.6	6.6	7.5	8.5	9.4	10.3	11.3	12.2	13.2	14.1
57	0.9	1.8	2.8	3.7	4.6	5.5	6.4	7.4	8.3	9.2	10.1	11.0	12.0	12.9	13.8
58	0.9	1.8	2.7	3.6	4.5	5.4	6.3	7.2	8.1	9.0	9.9	10.8	11.7	12.6	13.5
59	0.9	1.8	2.7	3.6	4.5	5.3	6.2	7.1	8.0	8.9	9.8	10.7	11.6	12.5	13.4
60	0.9	1.8	2.6	3.5	4.4	5.3	6.2	7.0	7.9	8.8	9.7	10.6	11.4	12.3	13.2
61	0.9	1.7	2.6	3.5	4.4	5.2	6.1	7.0	7.8	8.7	9.6	10.4	11.3	12.2	13.1
62	0.9	1.7	2.6	3.4	4.3	5.2	6.0	6.9	7.7	8.6	9.5	10.3	11.2	12.0	12.9
63	0.9	1.7	2.6	3.4	4.3	5.1	6.0	6.8	7.7	8.5	9.3	10.2	11.1	11.9	12.8
64	0.8	1.7	2.5	3.3	4.2	5.0	5.8	6.6	7.5	8.3	9.1	10.0	10.8	11.6	12.5
65	0.8	1.6	2.5	3.3	4.1	4.9	5.7	6.6	7.4	8.2	9.0	9.8	10.7	11.5	12.3
66	0.8	1.6	2.4	3.2	4.1	4.9	5.7	6.5	7.3	8.1	8.9	9.7	10.5	11.3	12.2
67	0.8	1.6	2.4	3.2	4.0	4.8	5.6	6.4	7.2	8.0	8.8	9.6	10.4	11.2	12.0
68	0.8	1.6	2.4	3.2	4.0	4.7	5.5	6.3	7.1	7.9	8.7	9.5	10.3	11.1	11.9
69	0.8	1.6	2.3	3.1	3.9	4.7	5.5	6.2	7.0	7.8	8.6	9.4	10.1	10.9	11.7
70	0.8	1.5	2.3	3.1	3.9	4.6	5.4	6.2	6.9	7.7	8.5	9.2	10.0	10.8	11.6
71	0.8	1.5	2.3	3.0	3.8	4.6	5.3	6.1	6.8	7.6	8.4	9.1	9.9	10.6	11.4
72	0.8	1.5	2.3	3.0	3.8	4.5	5.3	6.0	6.8	7.5	8.3	9.0	9.8	10.5	11.3
73	0.7	1.5	2.2	3.0	3.7	4.4	5.2	5.9	6.7	7.4	8.1	8.9	9.6	10.4	11.1
74	0.7	1.5	2.2	2.9	3.7	4.4	5.1	5.8	6.6	7.3	8.0	8.8	9.5	10.2	11.0
75	0.7	1.4	2.2	2.9	3.6	4.3	5.0	5.8	6.5	7.2	7.9	8.6	9.4	10.1	10.8
76	0.7	1.4	2.1	2.8	3.6	4.3	5.0	5.7	6.4	7.1	7.8	8.5	9.2	9.9	10.7
77	0.7	1.4	2.1	2.8	3.5	4.2	4.9	5.6	6.3	7.0	7.7	8.4	9.1	9.8	10.5
78	0.7	1.4	2.1	2.8	3.5	4.1	4.8	5.5	6.2	6.9	7.6	8.3	9.0	9.7	10.4
79	0.7	1.4	2.1	2.8	3.5	4.1	4.8	5.5	6.2	6.9	7.6	8.3	9.0	9.7	10.4

TABLE VI.—*Showing the Elastic Force of Aqueous Vapour.*

Temperature.	Force of Vapour.					Temperature.	Force of Vapour.				
	°0	°2	°4	°6	°8		°0	°2	°4	°6	°8
°	in.	in.	in.	in.	in.	°	in.	in.	in.	in.	in.
10	0·068	0·068	0·069	0·069	0·070	50	0·361	0·364	0·366	0·369	0·371
11	·071	·071	·072	·072	·073	51	·374	·377	·379	·382	·385
12	·074	·075	·075	·076	·077	52	·388	·391	·394	·397	·400
13	·078	·078	·079	·080	·081	53	·403	·406	·409	·412	·415
14	·082	·083	·083	·084	·085	54	·418	·421	·424	·427	·430
15	·086	·086	·087	·088	·089	55	·433	·436	·439	·443	·446
16	·090	·090	·091	·092	·093	56	·449	·453	·456	·459	·462
17	·094	·094	·095	·096	·097	57	·465	·469	·472	·475	·479
18	·098	·099	·100	·101	·102	58	·482	·485	·489	·492	·496
19	·103	·104	·105	·106	·107	59	·500	·503	·507	·511	·514
20	·108	·109	·110	·111	·112	60	·518	·522	·526	·529	·533
21	·113	·114	·115	·116	·117	61	·537	·541	·545	·548	·552
22	·118	·119	·120	·121	·122	62	·556	·560	·564	·568	·572
23	·123	·124	·125	·127	·128	63	·576	·580	·584	·588	·592
24	·129	·130	·131	·133	·134	64	·596	·601	·605	·609	·613
25	·135	·136	·137	·139	·140	65	·617	·622	·626	·630	·635
26	·141	·142	·143	·145	·146	66	·639	·644	·648	·652	·657
27	·147	·148	·149	·151	·152	67	·661	·666	·671	·675	·680
28	·153	·154	·156	·157	·158	68	·684	·689	·694	·699	·704
29	·160	·161	·162	·164	·166	69	·708	·713	·718	·723	·728
30	·167	·168	·170	·171	·172	70	·733	·738	·744	·749	·754
31	·174	·175	·176	·178	·179	71	·759	·764	·769	·774	·779
32	·181	·182	·184	·185	·186	72	·785	·790	·796	·801	·807
33	·188	·189	·191	·193	·194	73	·812	·818	·823	·829	·834
34	·196	·197	·199	·200	·202	74	·840	·846	·851	·857	·863
35	·204	·205	·207	·208	·210	75	·868	·874	·880	·885	·891
36	·212	·214	·215	·217	·218	76	·897	·903	·909	·915	·921
37	·220	·222	·224	·225	·227	77	·927	·934	·940	·946	·952
38	·229	·231	·232	·234	·236	78	·958	·965	0·971	0·977	0·984
39	·238	·239	·241	·243	·245	79	0·990	0·997	1·003	1·010	1·016
40	·247	·249	·251	·253	·255	80	1·023	1·030	·037	·043	·050
41	·257	·259	·261	·263	·265	81	·057	·064	·070	·077	·084
42	·267	·269	·271	·273	·275	82	·092	·099	·106	·114	·121
43	·277	·279	·281	·284	·286	83	·128	·135	·142	·150	·157
44	·288	·290	·293	·295	·297	84	·165	·173	·180	·188	·196
45	·299	·302	·304	·306	·308	85	·203	·211	·219	·226	·234
46	·311	·313	·316	·318	·321	86	·242	·250	·258	·266	·274
47	·323	·325	·328	·330	·333	87	·282	·290	·299	·307	·315
48	·335	·338	·340	·343	·345	88	·323	·332	·340	·349	·357
49	0·348	0·351	0·353	0·356	0·358	89	1·366	1·375	1·384	1·393	1·401

The Elastic Force of Aqueous Vapour is dependent upon the temperature of the dew-point. Table VI. gives the elastic force for every two-tenths of a degree of temperature, from 10° to 89° , the whole degrees being given in the vertical columns headed $\cdot 0$, and the tenths in the succeeding columns.

The Relative Humidity can be calculated by dividing the elastic force at the temperature of the dew-point by that at the temperature of the air (*i.e.* dry-bulb reading). Example: dry-bulb $55^{\circ}\cdot 0$, dew-point $46^{\circ}\cdot 5$; the elastic force corresponding to these will be $\cdot 433$ in. and $\cdot 317$ in. Therefore, dividing the latter by the former, the result is $0\cdot 73$; and taking saturation as 100, the relative humidity will be 73. In Table VII. is given the relative humidity

TABLE VII.—*For the Determination of Relative Humidity.*

Difference between Dry- and Wet-bulb Thermometers.	Temperature of the Air.									
	$30^{\circ}\cdot 0$	$35^{\circ}\cdot 0$	$40^{\circ}\cdot 0$	$45^{\circ}\cdot 0$	$50^{\circ}\cdot 0$	$55^{\circ}\cdot 0$	$60^{\circ}\cdot 0$	$65^{\circ}\cdot 0$	$70^{\circ}\cdot 0$	$75^{\circ}\cdot 0$
	%	%	%	%	%	%	%	%	%	%
$1^{\circ}\cdot 0$	83 \cdot 8	90 \cdot 2	91 \cdot 5	92 \cdot 0	92 \cdot 5	93 \cdot 1	93 \cdot 4	94 \cdot 0	94 \cdot 0	94 \cdot 5
$2^{\circ}\cdot 0$	69 \cdot 5	81 \cdot 4	83 \cdot 8	84 \cdot 9	85 \cdot 6	86 \cdot 6	87 \cdot 5	88 \cdot 3	88 \cdot 7	89 \cdot 2
$3^{\circ}\cdot 0$	57 \cdot 5	72 \cdot 5	76 \cdot 1	77 \cdot 9	79 \cdot 2	80 \cdot 6	81 \cdot 9	82 \cdot 5	83 \cdot 4	83 \cdot 9
$4^{\circ}\cdot 0$	47 \cdot 3	65 \cdot 2	69 \cdot 6	71 \cdot 9	73 \cdot 4	75 \cdot 1	76 \cdot 4	77 \cdot 3	78 \cdot 3	79 \cdot 1
$5^{\circ}\cdot 0$	38 \cdot 9	57 \cdot 8	63 \cdot 2	65 \cdot 9	67 \cdot 6	69 \cdot 7	71 \cdot 2	72 \cdot 4	73 \cdot 5	74 \cdot 7
$6^{\circ}\cdot 0$	32 \cdot 3	51 \cdot 5	57 \cdot 9	60 \cdot 5	62 \cdot 3	64 \cdot 4	66 \cdot 4	67 \cdot 9	69 \cdot 2	70 \cdot 4
$7^{\circ}\cdot 0$	27 \cdot 5	45 \cdot 6	52 \cdot 2	55 \cdot 5	57 \cdot 6	60 \cdot 0	62 \cdot 0	63 \cdot 7	64 \cdot 8	66 \cdot 4
$8^{\circ}\cdot 0$	22 \cdot 8	40 \cdot 2	47 \cdot 0	50 \cdot 5	53 \cdot 2	55 \cdot 4	57 \cdot 7	59 \cdot 3	60 \cdot 8	62 \cdot 3
$9^{\circ}\cdot 0$	18 \cdot 0	35 \cdot 3	42 \cdot 5	46 \cdot 5	49 \cdot 0	51 \cdot 7	53 \cdot 7	55 \cdot 6	57 \cdot 2	58 \cdot 6
$10^{\circ}\cdot 0$	15 \cdot 0	31 \cdot 9	38 \cdot 1	41 \cdot 8	44 \cdot 9	47 \cdot 8	50 \cdot 0	52 \cdot 0	53 \cdot 6	55 \cdot 2
$11^{\circ}\cdot 0$	.....	28 \cdot 4	34 \cdot 6	38 \cdot 1	41 \cdot 3	44 \cdot 1	46 \cdot 3	48 \cdot 5	50 \cdot 1	52 \cdot 0
$12^{\circ}\cdot 0$	.....	25 \cdot 5	30 \cdot 8	34 \cdot 4	37 \cdot 9	40 \cdot 9	43 \cdot 2	45 \cdot 2	47 \cdot 1	48 \cdot 8
$13^{\circ}\cdot 0$	.....	22 \cdot 5	27 \cdot 5	31 \cdot 1	34 \cdot 3	37 \cdot 6	40 \cdot 2	42 \cdot 1	44 \cdot 1	45 \cdot 7
$14^{\circ}\cdot 0$	.....	20 \cdot 1	25 \cdot 1	28 \cdot 4	31 \cdot 6	34 \cdot 9	37 \cdot 3	39 \cdot 2	41 \cdot 2	43 \cdot 0
$15^{\circ}\cdot 0$	.....	17 \cdot 6	22 \cdot 7	25 \cdot 4	28 \cdot 5	32 \cdot 1	34 \cdot 7	36 \cdot 6	38 \cdot 3	40 \cdot 4

for every 5° of temperature from $30^{\circ}\cdot 0$ to $75^{\circ}\cdot 0$, and each degree of difference between the dry- and wet-bulb readings from $1^{\circ}\cdot 0$ to $15^{\circ}\cdot 0$. This has been calculated to tenths to allow of the intermediate values being obtained with precision. If whole numbers are only required, the last figure should be increased when the decimal is $\cdot 5$ and above.

The foregoing are the necessary corrections, etc., to be applied to the various readings before they can be utilized for comparison with those at other places. In entering the observations in the register it is absolutely essential that they be *correctly* copied from the original note-book; it is most desirable, therefore, that the entries be afterwards *checked* by reference to the originals. In filling in the barometer readings, the whole inches may be omitted

when there are several of the same number together, except the first and last. In no other case, however, should any figure be omitted in any column, even though it be a cypher, as it may thereby cause an error in the adding up. In taking the sums or totals of the columns for the month, a convenient and simple method is the use of constants, or adopting some number common. For instance, in the barometer column it will be readily seen what is the prevalent number, 29 or 30 ins.; if 29 be taken as the constant, it will only be necessary to add up the figures to the right of the decimal point, and then to this total to add 1 for every inch above 29, and deduct 1 for every inch below. Example: If the total of the 3 columns to the right of the decimal add up to 21·648, and to the left of the decimal 30 ins. occurs 7 times, and 28 ins. 3 times, the other values being 29 ins.; then, by adding 7 for the 30 ins. and deducting 3 for the 28 ins., we get the following result: $7-3=4+21\cdot648=25\cdot648$ ins. This would, therefore, be the total for the barometer column, if 29 ins. were taken as the constant. Dividing the above figures by 31, which we will presume to be the number of days in the month, and adding 29 ins., the mean will be 29·827 ins. In the same way, constants may be employed in adding up the dry, wet, max., and min. thermometer columns. This method should be adopted, as it is the means of saving much time and labour, besides reducing the liability to error. Great care should be taken that the adding up is correct, and it is therefore desirable that the columns be added twice, first *upwards* and then *downwards*; so that if a mistake be made one way, it will most probably be found out the other way. The register should be complete, but if there be any omission in any of the columns, notice must be taken of it in obtaining the mean; instead of dividing by the number of days in the month, it will then be necessary to divide by the number of observations. In dividing the sums to obtain the mean, the last figure should always be increased if the remainder is more than half.

The mean temperature of the month may be obtained by adding together the dry-bulb readings at 9 a.m. and 9 p.m., the maximum, and the minimum, and dividing the sum by four.

28.—METEOROLOGICAL OBSERVATIONS TAKEN AT WANSFORD HOUSE,
WATFORD, DURING THE YEAR 1878.

By JOHN HOPKINSON, F.L.S., F.M.S., etc., Hon. Sec.

[Read 13th May, 1879.]

IN the year 1875 the Council appointed a Meteorological Committee to consider the question of having meteorological observations taken for the Society at Watford. This committee held but one meeting, presided over by the Earl of Essex, who was then taking meteorological observations at Cassiobury; and at this meeting it was recommended to the Council that an endeavour should be made to induce some member of the Society to take observations with verified instruments, and in accordance, in other respects also, with the rules of the Meteorological Society, so as to be comparable with observations taken at other places by that Society's observers.

No member could, however, be found who possessed the requisite instruments or was willing to obtain them and take regular observations; and in this emergency I undertook to endeavour to fulfil the requirements, procuring standard instruments which I had verified at the Kew Observatory, and commencing regular observations at Holly Bank early in the following year.

The results of these observations for a year and a half—March, 1876, to August, 1877—have already been communicated to the Society,* and during this period copies of the daily observations from which these results were deduced were forwarded monthly to the Meteorological Society.

In September, 1877, the observations were discontinued at Holly Bank, and from the following month they have been taken with the same instruments at my present residence, Wansford House. I must however state that at Wansford House they have not been taken quite in accordance with the Meteorological Society's rules, for I have discontinued taking the 9 p.m. observations. In other respects there has been no alteration; but this deviation is important, and renders the results given in this communication not strictly comparable with those previously given for Holly Bank, even had there been no difference in the locality and no alteration in the position of the instruments.

The requirements of the Meteorological Society for its second order stations, which are equivalent to the third order stations of the Meteorological Department of the Board of Trade, are not therefore now complied with; and I have given the foregoing particulars of the origin of these observations that I may ask for assistance from some member of the Society in relieving me of this work, which having been undertaken merely to supply a want, I would gladly give up to any one who would carry it on, by taking either only the 9 a.m., or, preferably, the 9 a.m. and 9 p.m. observations.

* 'Transactions,' Vol. I, p. 217, and Vol. II, p. 91.

The present locality is not quite so open as the former one, but there are no buildings sufficiently near to interfere with the indications of the thermometers or the rain-gauge, the position and exposure of which fulfil the requirements of the Meteorological Society. The wind-currents may possibly be slightly affected by the houses in the neighbourhood, and to a greater degree by the form of the ground; for the position is on a slight slope about half-way between the highest ground in the neighbourhood and the alluvial plain in the valley of the Colne, so that a northerly or southerly wind along the valley may be more felt than an easterly or westerly across it. This would affect the determination of the velocity more than that of the direction of the wind.

The longitude of the station is $0^{\circ} 23' 40''$ W. (of Greenwich), and the latitude is $51^{\circ} 39' 45''$ N. The centre of the town of Watford is scarcely half a mile to the south. The ground level, where the thermometer-screen and rain-gauge are placed, is 223 feet above Ordnance Datum (mean sea-level), and the cistern of the barometer is 233 feet 6 inches above this datum.

With regard to the instruments used, detailed particulars have already been given in our 'Transactions.'* The thermometers are, as before, four feet above the ground, in a "Stevenson" screen over grass, and the rain-gauge rim is one foot above the ground. A vane has been added by which the direction of the wind is now ascertained. It was constructed by Mr. Hicks, of Hatton Garden, by whom all my instruments have been made, and as it rotates with the slightest breath of air and has a good exposure, the direction of the wind will most probably be more accurately determined than before. The "Snowdon" rain-gauge alone has been used, the "Howard" having been left at Holly Bank for the continuance of observations there.

The whole of the observations are taken at 9 a.m., or sometimes a few minutes before that hour. The reading of the minimum thermometer is entered to the same day, and that of the maximum thermometer and the rain-gauge to the previous day. All the readings are corrected for the index errors of the instruments, and the readings of the barometer are corrected for temperature and altitude. The mean temperature is deduced from the readings of the dry-bulb (9 a.m.), the maximum, and the minimum thermometer, being the arithmetical mean of the three readings.

The accompanying tables (pp. 212, 213) give the monthly means of the daily observations, and of other results deduced from them.

The tables have been slightly altered from those given with the previous reports. The discontinuance of the 9 p.m. observations necessitating the mean temperature being deduced as already stated, I have thought it desirable to give, in the first table, the monthly mean readings of the dry-bulb thermometer at 9 a.m. They will be found to vary but slightly from the adopted monthly means; and in the year the difference is only $0^{\circ} 2$; while between the

* Vol. I, pp. 217, 218.

adopted mean and the mean of the maximum and minimum readings the difference in the year is only $0^{\circ}1$.

In accordance with the suggestion made by Mr. Greaves in his recent Anniversary Address as President of the Meteorological Society,* I have added a column headed "dryness." It expresses the difference between the temperature of the air and the temperature of the dew-point at 9 a.m. The dew-point temperature can therefore be readily ascertained; and from the values given in the table can be calculated, for 9 a.m., all the values here omitted, relating to the state of the air, which are given by Mr. Glaisher in his "Remarks on the Weather" in the Quarterly Reports of the Registrar-General, namely, mean pressure of dry air reduced to sea-level, mean weight of vapour in a cubic foot of air, mean additional weight required for saturation, and mean weight of a cubic foot of air.

In the second table the principal alteration is in the arrangement in three principal sections relating to rainfall, cloud, and wind. Columns showing the number of days of clear sky and overcast have also been added.

In the following summary of the principal results for the different seasons, December to February are considered as Winter months; March to May as Spring; June to August as Summer; and September to November as Autumn.

WATFORD.

Seasons 1877-78.	Mean Pressure.	Tension of Vapour.	Mean Tempera- ture.	Mean Daily Range.	Relative Humidity	Rainfall.
	ins.	in.	°	°	%	ins.
Winter.....	30·169	·217	39·7	10·5	90	5·71
Spring	29·912	·270	47·6	15·6	78	10·04
Summer	29·917	·409	61·1	16·3	74	11·27
Autumn	29·845	·300	48·4	13·8	85	7·63

For comparison the results of observations at the Greenwich Observatory are computed as before.

GREENWICH.

Seasons 1877-78.	Mean Pressure.	Tension of Vapour.	Mean Tempera- ture.	Mean Daily Range.	Relative Humidity	Rainfall.
	ins.	in.	°	°	%	ins.
Winter.....	30·160	·219	41·1	9·6	85	3·8
Spring	29·901	·265	48·5	16·3	77	9·7
Summer	29·913	·422	62·0	19·2	76	10·3
Autumn	29·838	·335	49·3	13·9	84	6·0

* 'Quart. Journ. Meteorological Society,' vol. v, p. 103.

RESULTS OF METEOROLOGICAL OBSERVATIONS TAKEN AT WANSFORD HOUSE, WATFORD, IN 1878—(continued).

MONTHS.	RAINFALL.				CLOUD.			WIND.										
	Total Fall. Ins.	Max. fall in 24 hours.		No. of days of		Mean Amount 0-10	No. of days of		Mean Force 0-12.	Number of days of								
		Ins.	Date.	Rain or Snow.	Snow only.		Clear Sky.	Over- cast.		N.	N. E.	E.	S. E.	S.	S. W.	W.	N. W.	Calm.
January	1'74	'32	27th	18	6	6'8	4	13	1'9	3	4	0	0	4	7	4	7	2
February	1'83	'43	13th	16	0	8'4	3	19	1'2	0	1	1	4	3	6	6	2	5
March	1'32	'56	28th	9	6	7'1	4	17	2'4	8	3	2	1	0	4	3	10	0
April	3'95	1'70	10th	14	1	5'1	8	8	2'0	2	5	7	4	3	4	2	1	2
May	4'77	'79	7th	24	0	8'0	1	12	1'9	0	5	1	4	5	8	2	6	0
June	4'82	1'99	30th	16	0	6'1	5	8	1'2	2	5	1	4	3	6	3	0	6
July	1'19	'54	24th	7	0	5'7	6	9	1'2	6	5	2	1	1	4	3	7	2
August	5'26	'68	13th	21	0	7'4	2	12	1'3	0	5	5	5	3	6	1	4	2
September	1'29	'25	22nd	13	0	6'2	8	6	1'4	3	0	1	1	2	5	9	7	2
October	2'05	'42	9th	15	1	6'9	4	10	1'7	2	2	3	2	6	7	3	3	3
November	4'29	'79	10th	21	2	7'1	3	14	1'4	7	5	0	0	2	2	1	7	6
December	1'76	'35	25th	16	10	6'7	5	17	1'2	4	5	1	3	0	1	6	5	6
Year.....	34'27	1'99	June 30	190	26	6'8	53	145	1'6	37	45	24	29	32	60	43	59	36

NOTES ON THE MONTHS.

The year 1878 was an exceptional one in many respects. It commenced with an unusually warm winter; it ended in one of exceptional severity. It was a year of excessive rainfall, of wet weather continued for long periods, and of heavy falls of rain of short duration. After a warm winter there followed a cold spring, or rather, there was no appreciable rise in temperature from the middle of winter—the coldest days of December or January—to the end of March, and April was but a little warmer. May and June were months of thunderstorms, July was generally fine and warm, August excessively wet, and the only fine autumnal weather was in September. In October a winter of almost unparalleled duration commenced, and throughout almost the entire month of December the ground was covered with snow.*

In the following notes on the months, these and other phenomena, so far as they are not shown in the tables, are briefly treated of.

JANUARY.

Atmospheric pressure was generally high throughout the month, but varied considerably. There were two well-marked minima—on the 7th, 29·630 ins., and on the 25th, 29·353 ins.—and two maxima—on the 11th, 30·646 ins., and on the 30th, 30·292 ins., the extreme range being thus 1·293 in. The most rapid rise in the barometer was from the 7th to the 11th, being 1·016 in. in four days.

Air temperature was mostly high, the minimum only sinking below 32° on eight days, and the maximum exceeding 40° on twenty-four, and 50° on seven days. The coldest days were the 11th (min. 21°·6, max. 37°·3) and 12th (min. 24°·4, max. 38°·2), corresponding with the days of greatest barometric pressure. A cold period set in again on the 23rd, when the mean temperature fell 13° below that of the previous day, and the cold weather continued to the 12th of February.

The prevailing direction of the wind was S. to S.W. the first week, then W. to N. to the 18th, S.W. to N.W. from the 19th to the 29th, and N.E. the last two days.

* As in the tables relating to the different seasons, results for the month of December, 1877, are necessarily included in the winter quarter, the results of observation taken in this month are here given:—

DECEMBER, 1877.

Pressure of atmosphere, 30·055 ins. Tension of vapour, 0·215 in.

Temperature of air—9 a.m., 38°·8; mean minimum, 35°·4; mean maximum, 45°·1; adopted mean, 38°·1; mean daily range, 10°·7; absolute minimum, 25°·0, on the 15th; absolute maximum, 52°·3, on the 6th.

Dryness, 2°·5. Relative humidity, 91 per cent.

Rainfall—total, 2·14 ins.; maximum fall, 0·62 in. on the 28th: days of rain, 19; snow only, 3.

Cloud—mean amount, 6·7: days of clear sky, 3; overcast, 14.

Wind—mean force, 1·3: days of N., 2; N.E., 2; S., 6; S.W., 9; W., 5; N.W., 5; Calm, 2.

Rain fell every day to the 9th (inclusive), ceasing with the rise in pressure and fall in temperature, none falling from the 10th to the 18th, after which, with one exception, there was rain or snow every day to the 28th, but with no very heavy fall.

Hoar frosts were recorded on the mornings of the 1st, 11th, 18th, 27th, 30th, and 31st.*

FEBRUARY.

The pressure of the atmosphere was higher than in any other month in the year, and was more equable than in January, the range being 0·843 in., from 29·800 ins. on the 14th to 30·643 ins. on the 22nd. For five consecutive days, the 4th to the 8th, the mercury stood above the unusual height of 30·500 ins.,† and the readings were below 30 inches on six days only.

The temperature of the air continued about the same as in January, the mean only showing an increase of 1°·1. The first half of the month was, indeed, considerably colder than the average of January, while the last half was much warmer, the mean from the 1st to the 12th being 34°·9, and from the 13th to the 28th, 44°·2. The maximum on the 17th (58°·8) calls for special remark as being unusually high for February.

The wind was westerly the first three days, easterly the next three, and generally S. to W. to the end of the month.

Scarcely any rain fell until the 8th, from which day to the 17th

* Although not connected with these observations at Watford, and perhaps more a geological than a meteorological phenomenon, this may be the only opportunity I may have of recording the extension to our County of the shock of earthquake which was felt in the south of England on the 28th of this month. Particulars of the shock as felt in the neighbourhood of London, in Kent, Sussex, Hampshire (including the Isle of Wight), Somersetshire, Devonshire, the Channel Islands, and at Paris, are given by our honorary member, Mr. J. G. Symons, F.R.S., in his 'Monthly Meteorological Magazine,' vol. xiii, p. 2, and in the 'Herts Advertiser' of the 1st of February the following letter appeared:—

"To the Editor of the Herts Advertiser."

"SIR,—On Monday last I was in an upper room of my house and distinctly felt a tremor or shaking of the room, so much so that I inquired if any heavy furniture was being moved in the lower rooms, or other cause. From the reports in the newspapers I find an earthquake has been felt in various parts of the country at the same time. This was about noon, the atmosphere was calm and my surroundings perfectly quiet. The trembling appeared to be between N.E. and S.W. There were three or four distinct vibrations. I unsuccessfully attempted to similarly shake the room, and came to the conclusion it was an earthquake, in which I have, from reports, been since justified.—Yours respectfully,

ST. PETER'S, ST. ALBANS,
Jan. 30th, 1878.

H. G. MARTIN."

The time stated, "about noon," must have been about 11·55 a.m., for the other records give the time as from about 11·50 to "a few minutes to 12," and the shock is supposed to have emanated "south of Paris—possibly under Auvergne." (Symons, *loc. cit.*)

† The following are the readings of the barometer taken at 9 a.m. on these days (corrected and reduced):—4th, 30·577 ins.; 5th, 30·635 ins.; 6th, 30·595 ins.; 7th, 30·641 ins.; 8th, 30·642 ins.

there was not a day without. After the 17th rain fell on only four days. There was no excessive fall; but on the three days from the 12th to the 14th rather more than 1 inch fell.

There were hoar frosts on the mornings of the 1st and 8th, and the mornings of the 15th and 19th were foggy.*

MARCH.

Atmospheric pressure was generally very high the greater part of the month, decreasing rapidly towards the end. The range, 1.425 in., was greater than in any other month in the year. The minimum, 29.229 ins., occurred on the 29th, and the maximum, 30.654 ins., on the 16th.

Temperature still continued low, the mean being only 2° higher than in January. The warm period, which commenced on the 13th of the previous month, continued to the 12th, the mean during this period being 45°·3. On the 13th there was a slight fall in temperature, which continued almost the same to the 17th, the mean of the five days being 37°·5. From the 18th to the 21st the mean was 47°, with a mean range under 2°, and from the 22nd to the end of the month the mean was 36°, being excessively low for the time of the year, and fully accounting for the low mean temperature of the month. The alternation of the two warm and cold periods, each persistent for several days, is remarkable.

The wind was generally westerly (S.W. to N.W.) to the 11th, N.E. from the 12th to the 16th, then N. to N.W. to the 26th, S.W. on the 27th, and north-easterly to the end of the month.

Scarcely any rain (or snow) fell until the 28th, and none whatever from the 2nd to the 8th, and (excepting a slight fall of snow on the 22nd, not giving 0.01 in. of rain, and therefore not recorded in the table) from the 12th to the 23rd. After the 23rd snow fell every day to the end of the month, except on the 25th and 27th.

A remarkably sudden squall, accompanied by a snow-storm, occurred on the 24th (Sunday), and from having caused the loss of H.M.S. *Eurydice*, is generally known as "the *Eurydice* squall." It was felt at Watford almost as severely as on the south coast. The night had been cold, the minimum being 25°·7, but the morning was warm with a slight N.W. breeze. At 9 a.m. the temperature had risen to 36°·9, and by 3 p.m. the maximum registered 44°·2. The barometer had fallen nearly an inch since the 20th, standing then, at 9 a.m., at 30.432 ins., and at the same hour on the 24th at 29.635 ins. At 3 p.m. pressure was still decreasing, the only indication of an approaching storm; but about this time, or a few

* Hoar frosts are mentioned as having been observed in the mornings, instead of in the nights, which would perhaps more correctly represent the time of their occurrence, simply because the observations are taken in the morning. They are only recorded when lasting until the hour of observation, 9 a.m., and therefore occurred more frequently than they are reported to have done in these notes. This explanation will also apply to the omission of notices of some other phenomena; and it may be stated that I can very seldom record any phenomena occurring at Watford between 9 a.m. and 6 or 7 p.m.

minutes later (between 3 and 3.10) there was a complete change in the weather; the wind, which had been gently blowing from W. or N.W., suddenly shifted to the north and blew with the force of a gale. The temperature sank to below freezing-point (32°) almost as suddenly, and a heavy fall of snow followed. The gale lasted scarcely an hour, and by 4.30 p.m. the weather was almost as fine and genial as before. In about half an hour after the storm was first felt at Watford it had reached the Isle of Wight, and had caused a disaster almost unparalleled in the annals of the British Navy. On the same day a thunderstorm occurred in the north of England.

APRIL.

The range in pressure was slightly above the mean for the year, being 1.052 in. The minimum, 29.157 ins., occurred on the 1st, and the maximum, 30.209 ins., on the 28th. The only considerable change in a short time was from the 1st to the 6th, in which time (five days) there was an increase of 1.006 in.

Air temperature rose pretty steadily throughout the month, resulting in a considerable increase over the mean for March, as may be seen from the table. In fact, in each week, from the last day in March to the first in May, inclusive, there was a decided increase in temperature.

The wind was westerly the first five days, then almost due E. to the 12th, S. to S.W. from the 13th to the 21st, E. or N.E. to the 29th, and S.W. on the 30th.

The rainfall was distributed over the month, there not being many days together without rain. The longest interval without was five days, from the 24th to the 28th. There was also a period of four days, from the 6th to the 9th, without rain, followed by an excessive fall amounting to 1.70 in. from 5 p.m. on the 10th to 9 a.m. on the 11th, and 0.39 in. from that hour to 1 p.m. the same day, giving over 2 inches in twenty hours. In some parts of London the fall was much heavier than at Watford, 4.62 ins. having fallen at Haverstock Hill in from seventeen to eighteen hours.* The flood which this storm caused at Watford, the highest known to have ever occurred here, has already been recorded in our 'Transactions.' †

MAY.

The pressure of the atmosphere varied from 29.308 ins. on the 24th to 30.165 ins. on the 30th, giving a range of 0.857 in. There was a somewhat rapid decrease to the minimum from 30.010 ins. on the 22nd, being 0.702 in. in two days.

The temperature rose gradually at the beginning and oscillated a little about the middle of the month, falling considerably between the 18th and 21st, after a thunderstorm and gale of wind which occurred on the night of the 17th-18th, and the mean from the 19th to the end of the month was $4^{\circ}.5$ lower than the mean from

* 'British Rainfall,' 1878, p. [83].

† Vol. II, p. xxv.

the 1st to the 18th, the temperature for the earlier period being $57^{\circ}\cdot 1$, and for the later $52^{\circ}\cdot 6$.

The wind was very unsettled the first eleven days, but most frequently easterly or westerly, from the 12th to the 20th it was either S. or S.W., south-westerly generally to the 26th, S. on the 27th, and N.E. the last three days.

There was a slight fall of rain on the 1st, and then none until the 6th, after which the 9th, 30th, and 31st were the only days without rain.

There were thunderstorms from 4.45 to 7 p.m. on the 1st; from 10 p.m. on the 10th to about midnight, with heavy rain lasting to 8.30 a.m. the following day; on the night of the 17th–18th, with strong wind and heavy rain ($0\cdot 55$ in.); and on the 28th, with $0\cdot 66$ in. of rain. Thunder was heard also on the 26th. The storm of the 1st was unusually severe and was generally felt over the London district, considerable damage being done by hail in the north of London.

JUNE.

The range in atmospheric pressure was less than in any other month in the year, being only $0\cdot 509$ in. The minimum, $29\cdot 686$ ins., occurred on the 12th, and the maximum, $30\cdot 195$ ins., on the 26th.

The temperature of the air was about the same as in May until the 20th, when a warm period commenced. On the 23rd there was another considerable rise in temperature, and from this day to the 29th inclusive the mean was $74^{\circ}\cdot 1$, being $13^{\circ}\cdot 8$ higher than the mean of the month. The maximum was above 80° on every day from the 23rd to the 28th, and it exceeded 70° on five other days.

The wind was generally easterly to the 9th, S.W. from the 10th to the 13th, then north-easterly to the 19th, S. for the next three days, then westerly, and S.E. to N.E. from the 26th to the end of the month.

Of the sixteen days of rain fourteen were between the 2nd and 19th inclusive, and during this time there was not a longer interval than one day without. After the 19th there was a slight fall on the 26th, and a very heavy one on the 30th.

There were thunderstorms every few days during the month, some of which were very severe. The days on which I have recorded them at Watford are the 4th, 8th, 16th, 18th, 23rd, 26th, and 30th. These storms all occurred in the afternoon or evening, and, with the exception of that on the 23rd, they occasioned considerable falls of rain. The intense heat which lasted the whole of the week from Sunday the 23rd to Saturday the 29th commenced and ended with thunderstorms of unusual severity. It is noteworthy that although much damage was done in the neighbourhood of London, especially in the northern districts, by excessive rainfall on the 23rd, none fell at Watford. The storm on the 26th was most severe in the neighbourhood of Rickmansworth, especially at Moor Park and at Batchworth. At Moor Park $1\cdot 07$ in. of rain was measured, most of which fell between 4 and 5 p.m. The storm was

nearest Watford at about 5 p.m. On the 30th, during the thunderstorm which lasted from noon to 3 p.m., I have 1·99 in. recorded; and on the same day Mr. Clinton Baker recorded 3·12 ins. between 11·30 a.m. and 4·30 p.m. at Bayfordbury, and Mr. James Mylne 2·35 ins. at Amwell from 11·30 a.m. to 5 p.m. In the neighbourhood of Hertford damage to the extent of some thousands of pounds was done by the excessive rainfall, many houses were inundated, several bridges were more or less completely destroyed, including the principal bridge in Hertford, which was entirely washed away, and others were much injured; at Hatfield several houses were flooded, including the Public Library, where some 500 volumes of books were spoiled, and the Post Office; and at Cheshunt and other places in the county many houses were flooded and considerable damage was done. A full account of this storm and of the damage done by it in the county appeared the 'Hertfordshire Mercury' of the 6th of July; and detailed accounts of this and the previous thunderstorms in June are given in Mr. Symons' 'Monthly Meteorological Magazine.' *

JULY.

Atmospheric pressure, which had been increasing during the latter part of June, continued generally high. The range up to the 19th, after which day, owing to my absence from home, barometric observations were not taken, was 0·491 in., from 29·872 ins. on the 2nd to 30·363 ins. on the 18th.

Air temperature was tolerably equable, and the mean was exactly 1° higher than in June. For the first three days, however, the temperature was rather low, from the 4th to the 9th high, from the 10th to the 16th low again, and the warmest period in the whole month was from the 17th to the 23rd.

The wind was northerly (N.E. to N.W.) for the first six days, then westerly to the 12th, northerly from the 13th to the 19th, then E., and S.W. to N.W. and N. for the remainder of the month.

From the 4th to the 24th only 0·02 in. of rain fell, there being thus about three weeks almost without rain, and nearly all the rain of the month fell therefore from that day to the 29th.

A thunderstorm occurred on the 24th, the only day on which there was any considerable amount of rain.

AUGUST.

Atmospheric pressure was low the greater part of the month, and showed a tendency to decrease from its commencement. It varied after the 6th, up to which date barometric observations were not taken, from 29·358 ins. on the 30th to 30·166 ins. on the 9th, giving a recorded range of 0·808 in.

Although the mean temperature was slightly higher than in July, there was no very warm period, and the maximum was under 77°.

The wind varied from N.E. to S.E. to the 6th, was generally westerly or south-westerly to the 18th, almost due E. from the

* Vol. xiii, pp. 81-89, and 97-99.

19th to the 24th, and then varying, from almost every point of the compass, to the end of the month.

The rainfall was excessively heavy, this being the wettest month in the year. There were not more than two days together without rain, and from the 9th to the 16th rain fell every day. With this almost continuous wet weather there were also many heavy falls, mostly occasioned by thunderstorms, more than half an inch of rain falling on the 3rd, 10th, 13th, and 22nd, and about the third of an inch on the 5th, 29th, and 31st.

A severe thunderstorm occurred on the 10th, lasting from about 7.30 to 8.15 p.m., with a fall of 0.52 in. of rain, and thunderstorms also occurred on the 3rd, 4th, 23rd, and 24th, that on the 3rd being accompanied by a fall of 0.83 in. of rain.

There was a gale of wind on the night of the 29th and morning of the 30th.

SEPTEMBER.

Atmospheric pressure was high and equable as in July the first half of the month, but afterwards lower and more variable. The range was 0.559 in., from 29.727 ins. on the 25th to 30.286 ins. on the 2nd.

Air temperature also did not vary much, but the last half of the month was decidedly cooler than the first half, the decrease from August in mean temperature being entirely due to the last fifteen or sixteen days.

The prevailing direction of the wind was northerly to the 13th, but S., S.W., or W. occasionally, S.W. or W. from the 14th to the 24th, S.E. on the 25th, and south-westerly for the remainder of the month.

The small amount of rain which fell was distributed pretty evenly over the month, but the rainfall was less during the first than during the second half of the month, corresponding with the difference in barometric pressure.

OCTOBER.

The pressure of the atmosphere varied from 29.005 ins. on the 26th to 30.352 ins. on the 13th, giving a range of 1.347 in., considerably more than in the previous five months. There was a considerable barometric depression from the 2nd to the 10th, followed by a very rapid rise, from 29.259 ins. at 9 a.m. on the 10th to 30.385 ins. at 9 a.m. on the 12th (1.126 in. in two days), after which pressure decreased gradually to the minimum on the 26th, increasing to the end of the month.

Temperature fell considerably, and the long severe winter of 1878-79 may be said to have begun on the 27th, for the mean temperature of the last five days in the month was as low as 38°·5, or 16°·0 below the mean of the month. The minimum sank to below 32° on three days, the 13th, 27th, and 30th.

The wind was southerly, inclining to W., to the 13th, E. or N.E. to the 20th, and south-westerly (occasionally N.W.) to the end of the month.

No rain fell until the 6th, then there was rain every day until the 10th, scarcely any for the next ten days, and from the 21st a considerable amount nearly every day to the end of the month.

There was a dense fog on the 17th, and again on the 21st, a heavy gale of wind on the night of the 29th, and a slight fall of snow on the 30th.

NOVEMBER.

The range in atmospheric pressure was again considerable, being 1.198 in., from 29.252 ins. on the 16th to 30.450 ins. on the 19th, a very rapid rise in the three days. Pressure varied also very considerably several times during the month. Commencing high, there was a decrease every day, except on the 9th, from 30.232 ins. on the 3rd to the minimum on the 16th, and after a high period, from the maximum on the 19th to the 24th, there was a sudden fall of the mercury, followed by an equally sudden rise on the 29th.

Temperature also varied considerably, but there was a general decrease throughout the month. The minimum, on the 23rd, was much lower than any recorded for several days before or after, and it is remarkable that the maximum occurred so near as the 24th, and though unusually low was only approached within 4° on the 10th and 25th. The minimum sank to below 32° on eight days, and the minimum of the 23rd ($25^{\circ}6$) was nearly reached on the 30th, when $26^{\circ}3$ was recorded.

The wind was northerly to the 7th, then generally westerly to the 17th, and W., N., or E. for the remainder of the month.

Rain fell nearly every day, excepting from the 1st to the 3rd and from the 19th to the 22nd, the only other days without rain being the 5th and the 29th. The maximum of the 10th was nearly equalled on the previous day, when 0.76 in. fell; on the 15th there was a fall of 0.61 in., and on the 27th of 0.57 in., making four excessive falls in the month. There was a slight fall of snow on the 12th.

On the nights of the 9th-10th, and 15th-16th, there were gales of wind; and hoar frosts were recorded on the mornings of the 12th, 19th, and 23rd. The 24th was foggy.

DECEMBER.

Again there was a considerable variation in atmospheric pressure, though not so great as in either of the two previous months. The minimum was 29.195 ins., on the 19th, and the maximum 30.344 ins., on the 24th, giving a range of 1.149 in. There was a sudden rise of the mercury from 9 a.m. on the 1st to 9 a.m. on the 2nd, followed by a sudden fall from the 6th to the 7th, from which day pressure continued low until the 24th. From that day, at 9 a.m., to the same hour on the 26th, there was a fall of about one inch, the pressure on the 26th being 29.383 ins., and from then to the end of the month the mercury continued low.

The temperature of the air was again unusually low, excepting during the last two days, the mean of which was about 20° higher

than the mean of the month. The mean from the 1st to the 5th was $39^{\circ}\cdot8$, about the average for the time of the year; from the 6th to the 25th, $28^{\circ}\cdot3$, a long period of excessively cold weather, during which the maximum temperature reached was only $38^{\circ}\cdot5$ (on the 19th); from the 26th to the 29th, $39^{\circ}\cdot6$, again about the average for December; and on the 30th and 31st, $52^{\circ}\cdot2$. Until the 26th the maximum never reached 44° . The minimum rose from $12^{\circ}\cdot2$, $15^{\circ}\cdot1$, and $8^{\circ}\cdot8$, on the 23rd, 24th, and 25th, respectively, to $28^{\circ}\cdot0$ on the 26th, $40^{\circ}\cdot0$ on the 27th, and on the 31st $49^{\circ}\cdot3$; the maximum from $31^{\circ}\cdot5$, $30^{\circ}\cdot5$, and $31^{\circ}\cdot0$, on the 23rd, 24th, and 25th, to $45^{\circ}\cdot5$ on the 26th and $54^{\circ}\cdot7$ on the 30th; and the 9 a.m. temperature from $27^{\circ}\cdot0$, $22^{\circ}\cdot5$, and $28^{\circ}\cdot8$, on the 23rd, 24th, and 25th, to $41^{\circ}\cdot0$, $42^{\circ}\cdot5$, and $53^{\circ}\cdot3$, on the 26th, 27th, and 30th! The few days before the thaw, which commenced on the morning of the 26th, were thus remarkably cold, while after the thaw the weather was unusually warm for the time of the year. The minimum sank to below 32° on twenty-two days, to below 25° on eleven, to below 20° on five, and to below 12° on two.

The prevailing direction of the wind was northerly, inclining to W., to the 12th, N.E. the next two days, generally westerly to the 24th, E. on the 25th, and from then to the end of the year south-westerly.

Rain fell on the 1st, and every day from the 26th to the end of the month. Between these dates snow only fell, the total amount of which, on the ten days on which it fell, nearly equalled the total amount of rain. Snow laid on the ground from the first fall on the 5th, until and for a day or two after the thaw on the 26th.

There were hoar frosts on the mornings of the 9th to the 14th; the mornings of the 16th, 27th, and 28th were foggy; and the year closed with a heavy gale of wind which lasted from the night of the 29th to the morning of the 31st.

29.—REPORT ON THE RAINFALL IN HERTFORDSHIRE IN 1878.

By JOHN HOPKINSON, F.L.S., F.M.S., Hon. Sec.

[Read 13th May, 1879.]

SINCE the previous year a few changes have been made in the stations from which returns of the rainfall have been received, but the number of stations and of observers is the same as before. For Watford we have not received returns for last year from three of the places at which observations were taken during the two previous years, namely, Watford House, Holly Bank, and Cassiobury. In place of these the only additional station is Wansford House, where the observations commenced at Holly Bank are now continued. Watford is still, however, well represented by the three places from which returns have been received, Bushey Station representing one end of the town, the south-east; Wansford House, towards the other end, the north-west, taking the place of Watford House, a few hundred yards distant; and Oaklands, still further to the north-west, well representing the area in which Holly Bank and Cassiobury are situated. Besides the loss of three stations at Watford, the only other place at which observations have been discontinued is Hoddesdon, where I hope we may soon again have an observer. Against these four losses we have the new station at Watford, Brocket Hall near Welwyn, Datchworth, and High Down near Hitchin, added.

In this report an alteration is made in the arrangement of the river-basins represented, the station at Cowroast, near Tring, having before been wrongly referred to the basin of the Thame.* It is in reality in the basin of the Bulborne, near the present source of this river, and not far from the source of the Thame. We have therefore, and have had so far, only three of the main river-basins represented—the Colne, the Lea, and the Ouse. For the Thame we require an observer in the neighbourhood of Puttenham, or of Long Marston, or beyond, at the extreme western corner of Hertfordshire; and for the Brent we require an observer in the neighbourhood of Totteridge. A very small portion of Hertfordshire is, however, comprised in the areas drained by these rivers. Of the sub-divisions of the two larger river-basins which extend over almost the entire county, of the Colne all are represented except the Upper Colne and the Chess, and of the Lea all but the Stort. An observer is therefore required in the district to the south-east of St. Albans to represent the basin of the Upper Colne; in the district between Rickmansworth and Chesham to represent the basin of the Chess; and in the neighbourhood of Sawbridge-worth or Bishop's Stortford to represent the basin of the Stort. There are also other districts where it would be an advantage to have additional observers, and in order to show clearly where

* In the tables giving the rainfall in 1876 and 1877, 'Transactions,' Vol. I, p. 227, and Vol. II, p. 99.

STATIONS.	JAN.	FEB.	MAR.	APR.	MAY.	JUNE.	JULY.	AUG.	SEPT.	OCT.	NOV.	DEC.	TOTAL.	DAYS.
	ins.	ins.	ins.	ins.	ins.	ins.	ins.	ins.	ins.	ins.	ins.	ins.	ins.	
Wattford—Bushey Station	1'44	1'56	1'20	4'24	4'38	4'41	'73	5'68	1'51	1'85	4'25	1'75	33'00	
Wansford House.....	1'74	1'83	1'32	3'95	4'77	4'82	1'19	5'26	1'29	2'05	4'29	1'76	34'27	190
" Oaklands.....	1'64	1'73	'93	4'24	4'64	5'27	'89	5'07	1'38	1'95	4'48	1'45	33'67	179
Rickmansworth—Moor Park	1'61	1'76	1'19	3'40	4'52	5'75	1'14	6'15	1'45	2'17	4'27	1'61	35'02	198
St. Albans—Gorhambury	1'06	1'38	'54	4'46	5'27	2'47	'96	4'87	'81	1'56	3'05	'95	26'37	144
Harpenden—Rothamsted	1'73	1'77	'88	4'01	4'89	2'46	'64	4'87	1'41	2'99	4'73	1'57	31'96	195
" (2nd gauge)	1'75	1'80	'98	4'09	4'98	2'50	'66	4'98	1'46	2'99	4'54	1'60	32'33	195
Kensworth	1'96	1'62	'68	5'19	5'58	2'36	1'14	5'13	1'41	2'45	4'57	1'49	33'58	159
Hemel Hempstead—Nash Mills	1'61	1'93	1'01	3'92	4'37	2'80	1'30	4'84	1'23	2'08	4'12	1'16	30'37	171
Berkhamstead	1'62	1'84	1'12	3'60	4'60	2'38	1'39	7'12	1'33	2'62	5'15	1'39	34'16	167
Great Gaddesden	1'40	1'54	'74	3'42	4'06	2'24	1'22	5'28	1'20	2'36	4'25	1'29	29'00	
Tring—Cowroast	1'86	1'59	1'02	3'59	4'44	2'24	1'11	5'56	1'49	2'78	4'79	1'53	32'00	145
East Barnet—Southgate	1'44	1'57	1'14	4'56	4'26	4'83	'67	6'39	'98	1'83	3'36	1'60	32'63	165
Hertford—Bayfordbury	1'39	1'48	1'05	2'76	3'86	5'09	1'39	7'64	1'22	1'55	3'94	1'10	32'47	162
Ware	1'18	1'18	1'06	2'02	4'28	2'65	1'42	4'63	1'26	1'55	4'06	1'17	26'46	178
Hatfield—Brockett Hall	1'26	1'67	'89	4'01	3'13	1'71	1'00	5'95	1'29	1'95	4'41	3'01	30'28	151
Welwyn Rectory	1'17	1'50	1'39	2'85	4'51	2'24	1'03	5'10	1'22	2'18	4'61	1'34	29'14	191
Datchworth	1'24	1'33	2'38	1'00	4'53	1'51	1'19	5'59	1'00	1'92	4'13	1'17	26'99	154
Knebworth	1'72	1'56	1'12	3'14	4'72	2'31	'93	6'01	1'16	2'65	4'28	1'37	30'97	161
Stevenage	1'43	1'43	1'16	2'20	4'69	2'30	1'50	4'71	1'04	2'13	4'34	1'21	28'14	178
Buntingford—Aspenden	1'42	1'32	1'39	1'40	5'28	2'07	'81	4'14	1'07	2'61	4'58	1'10	27'19	162
Therfield	1'47	1'15	'98	1'38	4'26	1'72	'62	4'60	1'03	1'94	3'93	1'34	24'42	154
Much Hadham	1'55	1'40	1'57	1'88	4'55	3'62	'53	4'64	1'17	1'83	4'92	1'28	28'94	176
Hitchin	1'51	1'28	1'20	2'35	4'69	2'43	1'20	5'79	'96	1'83	3'85	1'19	28'30	194
" High Down.....	1'50	1'29	'21	3'19	4'31	2'35	'98	5'05	1'40	1'80	3'72	1'22	27'00	
Odsey	1'33	1'00	1'10	1'43	3'79	1'70	'72	4'24	'81	1'74	3'59	1'07	22'52	172
Royston	1'66	1'11	1'03	1'73	3'89	1'47	'33	4'39	'79	1'97	3'84	1'15	23'36	157
Mean	1'51	1'50	1'09	3'12	4'49	2'88	'99	5'28	1'20	2'12	4'22	1'40	29'80	170

COLNE.

LEA.

OUSE.

observers are most required I purpose to give with a future report a map showing the position of the rain-gauges in the county.

Particulars of the gauges, with the names of the observers, and the monthly and annual rainfall (including melted snow) at each of the stations, are given in the accompanying tables (pp. 224, 225).

In the form of these tables I have made some alterations from the similar tables in previous reports. To the table showing the "Hertfordshire Rainfall Stations" have been added the river districts, the latitude and longitude of each station, and a column showing the method by which the height of each gauge above mean sea-level (Ordnance datum) has been determined. The symbols are those used by Mr. Symons in 'British Rainfall,' ∇ signifying that a series of levels has been taken to the gauge from an Ordnance bench-mark, T that the height has been ascertained approximately from the same source, L that levels have been taken to the gauge from some datum other than Ordnance mean sea-level, and B that the height has been taken by the barometer. The latitude and longitude are given approximately in order partly that the observers may correct any error in the position assigned to their gauges before the proposed map is prepared.*

To the table of monthly and annual rainfall a column giving the number of days on which .01 inch of rain, or more, fell during the year, has been added, and the minor river-districts have been omitted, being transferred to the first table.

The rainfall will be seen to have been, as in 1876, very unequally distributed over the year. May, August, and November, were the wettest months, the fall in each month exceeding four inches, and the mean for the three being 4.66 ins.; then follow April, June, and October, each with a fall exceeding two inches, and the three having a mean of 2.71 ins.; and lastly, in the six remaining months—January, February, March, July, September, and December—the fall varied from about an inch to an inch and a half, and their mean fall was only 1.29 in., about one-fourth the mean of the three wettest months.

The next table gives the mean rainfall for the year for each of the larger divisions or main river-basins, and also for each of the smaller districts or lesser river-basins in which we have observers.

Colne.....32.14	{ Lower Colne.....	33.99	Lea.....29.13	{ Lower Lea	32.63
	{ Ver	31.06		{ Upper Lea	29.76
	{ Bulborne	31.38		{ Mimram	29.14
Ouse 25.29	{ Ivel	27.65		{ Ash	28.70
	{ Cam	22.94		{ Beane	25.80
				{ Rib	28.96

The relative proportion of the rainfall in the larger divisions will be seen to be the same as during the two previous years, the basin of the Ouse having the least, that of the Lea having the next, and that of the Colne having the greatest fall.

Of the 26 observers 21 give the number of days in each month

* I wish particularly to draw the attention of observers to these figures.

on which 0·01 inch of rain, or more, fell, and also the greatest amount of rain which fell on any one day in each month. The mean number of rainy days in each month is as follows:—

Jan.	15·0	April.....	13·9	July	6·1	Oct.	14·5
Feb.	13·6	May	22·5	Aug.....	20·0	Nov.	18·4
March	9·9	June.....	13·9	Sept.	10·7	Dec.	11·8

giving a mean for the year of 170·3 days, being about three days less than in 1876, and 23 days less than in 1877.* The least number of rainy days were at St. Albans (144) and Tring (145); the greatest, at Hitchin (194), Harpenden (195), and Rickmansworth (198). The numbers nearest the mean were at Hemel Hempstead (171) and Odsey (172).

The station at which there was the greatest fall of rain in 24 hours in each month is now given, with the day of the month and the amount of the fall.

	ins.		ins.
Jan. 28.—Kensworth.....	·54	July 24.—Nash Mills.....	1·14
Feb. 13.—".....	·60	Aug. 23.—Kensworth.....	1·52
Mar. 28.—Wansford House	·56	Sept. 18.—East Barnet	·47
Apl. 10.—East Barnet	2·56	Oct. 21.—Rothamsted	1·10
May 7.—Aspenden	1·20	Nov. 15.—Aspenden	1·19
June 30.—Bayfordbury [†]	3·68	Dec. 27.—Brocket Hall.....	·92

The days on which the greatest fall of rain is recorded in each month at these 21 stations are next given, with the number of stations at which this maximum monthly fall occurred. The days on which the greatest rainfall in the month occurred at any one station, as shown above, are indicated by italics.

January—5th, the wettest day at 2 stations; 27th at 15; 28th at 4.

February—13th at 19; 14th at 2.

March—21st at 1; 28th at 6; 29th at 6; 30th at 1; 31st at 7.

April—10th at 16; 11th at 1; 20th at 4.

May—1st at 1; 7th at 18; 12th at 1; 17th at 1.

June—3rd at 3; 11th at 1; 12th at 6; 13th at 1; 17th at 1; 30th at 9.

July—5th at 1; 24th at 13; 26th at 3; 27th at 4.

August—4th at 2; 5th at 6; 10th at 1; 13th at 4; 23rd at 3; 29th at 5.

September—8th at 1; 15th at 1; 17th at 12; 18th at 4; 22nd at 2.

October—9th at 4; 18th at 1; 21st at 8; 24th at 5; 25th at 1; 30th at 2.

November—10th at 6; 14th at 2; 15th at 6; 26th at 1; 27th at 5; 30th at 1.

December—25th at 3; 26th at 7; 27th at 10; 31st at 1.

The following falls of an inch or more are recorded on the days of maximum monthly fall.

April 10—Wansford House, Watford, 1·70; Oaklands, Watford, 1·45; Gorhambury, St. Albans, 1·80; Rothamsted, 1·74; Kensworth, 1·75; Nash Mills, 1·57; Berkhamstead, 1·20; Tring, 1·23; East Barnet, 2·56; Bayfordbury, 1·43; Brocket Hall, Hatfield, 2·11; Welwyn Rectory, 1·48; Datchworth, 1·05.

May 7—Aspenden, 1·20; Much Hadham, 1·04; Hitchin, 1·05; Odsey, 1·02.

* In the Report for 1877 ('Transactions,' Vol. II, p. 98), the mean number of rainy days in the year is stated to have been 10½ more than in 1876. This is a misprint for 20½, and escaped my notice until now.

June 30—Wansford House, Watford, 1·99; Oaklands, Watford, 2·77; Moor Park, Rickmansworth, 1·35; East Barnet, 1·85; Bayfordbury, 3·68; Ware, 1·38; Much Hadham, 1·95.

July 14—Nash Mills, 1·14; Berkhamstead, 1·09.

August 4—East Barnet, 1·24; Hitchin, 1·10.

Aug. 5—Bayfordbury, 1·14; Datchworth, 1·11.

Aug. 10—Moor Park, 1·01.

Aug. 23—Kensworth, 1·52.

Aug. 24—Berkhamstead, 1·50.

Aug. 29—Rothamsted, 1·04.

October 21—Rothamsted, 1·10.

November 14—Much Hadham, 1·05.

Nov. 15—Aspenden, 1·19.

The most remarkable feature of the rainfall in 1878 is the number of heavy falls of rain and snow, and the excessive amount of some of these falls. The floods from the fall on the 30th of June did much damage, especially in the neighbourhood of Hertford. It was not, however, an excessively wet day all over the county, for the fall was the heaviest in the month at only 9 stations out of 21. On the 10th of April the fall, which occasioned the highest flood ever recorded in the neighbourhood of Watford,* was more generally a heavy one, being the greatest in the month at 16 stations. The falls on the 13th of February and 7th of May seem to have been most generally heavy, for they were the greatest in those months at 19 and at 18 stations respectively. Falls exceeding one inch occurred in four months of 1876, in five months of 1877, and in seven months of 1878, which is therefore an exceptional year, both as to the excessive amount of several of the falls of rain, and the general dispersion of heavy falls over the different months of the year.

Reports on the rainfall in Hertfordshire have now been given for four years, from a few stations for 1875, and for stations distributed over every part of the County for the last three years, and every year of the four the fall has been considerably above what the average for a long period would be. It is therefore evident how uncertain any deductions from the records of a limited number of years must be, and it seems probable that a period of something like a quarter of a century must be required to enable a deduction within moderate limits to be made of the average yearly fall of rain at any locality or in any county.

* See 'Transactions,' Vol. II, p. xxv.

30.—REPORT ON PHENOLOGICAL OBSERVATIONS IN HERTFORDSHIRE
IN 1878.

By JOHN HOPKINSON, F.L.S., F.M.S., Hon. Sec.

[Read 13th May, 1879.]

It is satisfactory to be enabled to report that the number of localities at which Phenological Observations were taken in 1878 is considerably greater than in either of the two previous years. In 1876 we had returns from Watford and Ware only, in 1877 to these localities Odsey was added, and now we have also returns from St. Albans, Redbourn Bury, Harpenden, and Hertford.

The observations for Ware are contributed by Lieut. R. B. Croft, F.L.S., of Fanhams Hall, and for Odsey by Mr. H. George Fordham, F.G.S., of Odsey Grange, as before. For Watford I have had valuable assistance which I have not previously had the advantage of, and one result of this may be seen in the increased number of species (mostly of plants) observed. At St. Albans observations of insects and birds have been made by the Rev. C. M. Perkins, M.A.; and for the district between St. Albans and Redbourn observations of the time of flowering of plants have been received from Mrs. Arnold, of Redbourn Bury. For Harpenden Mr. John J. Willis has furnished the most complete diary of the flowering of plants we have as yet received from any part of the county; and for Hertford we have a few observations from Mr. R. T. Andrews.

From south-west to north-east these localities may be arranged as follows:—Watford, St. Albans, Harpenden, Hertford, Ware, Odsey. It may perhaps be well to give here the latitudes and longitudes of these places.

	N. Lat.	W. Long.		N. Lat.	W. Long.
Watford	51° 39'	0° 24'	Hertford	51° 47'	0° 5'
St. Albans *.....	51° 46'	0° 23'	Ware†	51° 49'	0° 1'
Harpenden	51° 48'	0° 21'	Odsey	52° 1'	0° 7'

A few observations of birds, recorded in the neighbourhood of Hunton Bridge by Mr. J. E. Littleboy and already communicated to the Society by him, are also incorporated. The locality being so near Watford these observations may be considered to pertain to the Watford district, to our records for which they are a material addition.

As in the last report, there are very few instances in which it has been found necessary to alter the dates of observation. In each case three days have been subtracted from the actual date returned. This alteration occurs only in four species of plants, which evidently opened their flowers before they were actually observed, and from other records it is probable that the alteration is rather under than over the mark.

* Redbourn Bury.

† Fanhams Hall.

DATES OF FLOWERING OF PLANTS OBSERVED IN 1878.

No.	SPECIES.	WATFORD.	ST. ALBANS.	HARPENDEN.	HERTFORD.	WARE.	ODSEY.	MEAN, 1876-78.
1.	<i>Anemone nemorosa</i> (wood anemone)	.....	Mar. 8	Mar. 10	.....	Mar. 8	.....	Mar. 18
2.	<i>Ranunculus Ficaria</i> (pilewort)	Feb. 28	Feb. 28	Feb. 26	.....	Feb. 21	.....	Feb. 26
3.	<i>Ranunculus acris</i> (upright crowfoot)	May 4	.....	Apl. 17	.....	May 3	.....	Apl. 26
4.	<i>Caltha palustris</i> (marsh marigold)	.....	Mar. 13	Apl. 7	.....	Mar. 21	.....	Mar. 19
5.	<i>Papaver Rhoeas</i> (red poppy)	.....	June 1	June 1	June 6	May 31	May 26	May 27
7.	<i>Cardamine pratensis</i> (cuckoo-flower)	Apl. 7	.....	Apl. 7	.....	Apl. 8	.....	Apl. 11
8.	<i>Draba verna</i> (whitlow grass)	Feb. 27.(?)	.....	.....	.....	.....	.....	Feb. 27
9.	<i>Viola odorata</i> (sweet violet)	Mar. 4	Mar. 7	.....	.....	.....	Mar. 3	Feb. 25
10.	<i>Polygala vulgaris</i> (milkwort)	.....	.....	May 29.(?)	.....	.....	May 10	May 19
11.	<i>Lychnis Flos-cuculi</i> (ragged Robin)	.....	.....	May 29	.....	.....	.....	June 3
12.	<i>Stellaria Holostea</i> (greater stitchwort)	Mar. 24	Mar. 28	Mar. 27	.....	Apl. 10	.....	Mar. 29
13.	<i>Malva sylvestris</i> (common mallow)	May 30	June 3	.....	June 3	June 3	.....	June 8
14.	<i>Hypericum tetrapetrum</i> (square St. John's wort)	.....	.....	July 10	.....	.....	.....	July 10
15.	<i>Hypericum pulchrum</i> (upright St. John's wort)	June 27	.....	June 25	.....	.....	.....	June 25
16.	<i>Geranium Robertianum</i> (herb Robert)	Apl. 28	.....	May 5	May 27	May 1	.....	Apl. 26
17.	<i>Trifolium repens</i> (Dutch clover)	May 9	.....	May 6	.....	May 24	May 12	May 22
18.	<i>Lotus corniculatus</i> (bird's-foot trefoil)	May 15	June 3	May 14	.....	May 31	.....	May 26
19.	<i>Ficaria Cracca</i> (tufted vetch)	.....	.....	June 25	.....	.....	.....	June 27
20.	<i>Ficaria sepium</i> (bush-vetch)	Apl. 24	.....	Apl. 22	.....	Apl. 30	.....	May 4
21.	<i>Lathyrus pratensis</i> (meadow vetchling)	May 30	June 7	June 8	.....	.....	.....	June 8
22.	<i>Prunus spinosa</i> (blackthorn)	.....	Mar. 11	Feb. 27	.....	Mar. 16	Mar. 12	Mar. 11
23.	<i>Spiraea Ulnaria</i> (meadow sweet)	June 22	June 18	June 17	.....	May 16	.....	June 20
24.	<i>Potentilla anserina</i> (silver-weed)	May 15	.....	May 18	.....	Mar. 15	May 11	May 23
25.	<i>Potentilla Fragariastrum</i> (barren strawberry)	Mar. 6	Mar. 4	Mar. 9	.....	May 30	.....	Mar. 13
26.	<i>Rosa canina</i> (dog rose)	May 26	May 19	May 29	.....	May 27	.....	June 5
27.	<i>Epilobium hirsutum</i> (great hairy willow-herb)	.....	.....	July 7	.....	.....	.....	July 7
28.	<i>Epilobium montanum</i> (broad willow-herb)	.....	.....	June 7	.....	.....	.....	June 12
30.	<i>Anthriscus sylvestris</i> (wild chervil)	Mar. 21	Apl. 6	Mar. 15	.....	.....	.....	Apl. 9
31.	<i>Hedera Helix</i> (ivy)	Sept. 7	.....	Sept. 27	.....	.....	Sept. 20	Oct. 10
32.	<i>Galium Aparine</i> (cleavers)	May 12	.....	May 17	.....	May 17	May 11	May 20
33.	<i>Galium verum</i> (yellow bedstraw)	June 29	.....	June 29	.....	.....	June 27	June 30

As shown in the table here given (pp. 230, 231) the time of flowering of 64 species of plants has been observed in the county, out of a total of 71 in the Meteorological Society's list,* two of which moreover (*Cardamine hirsuta* and *Gentiana campestris*) are rarely met with in Hertfordshire, leaving only five species of frequent occurrence unobserved.

Of these 64 species we observed 44 at or near Watford, 20 were observed by Mrs. Arnold at Redbourn Bury near St. Albans, 57 by Mr. Willis at Harpenden, 4 by Mr. Andrews at Hertford, 32 by Mr. Croft in the neighbourhood of Ware, and 21 by Mr. Fordham at Odsey.

The earliest dates, in proportion of the number of species observed, are those recorded for Watford, then follow Odsey, St. Albans, and Harpenden, very nearly equal, Ware is the next in order, and Hertford the last.

Comparing this year with the mean of the two previous years, we find that out of 38 species of plants observed in all three years, 25 came into flower earlier and 3 later in 1878 than in 1876 and 1877, while 10 flowered at about the same time in all three years. We have before seen that in the state of vegetation generally 1876 and 1877 were about equal,† and therefore 1878 may be said to be an early year as compared with the mean of the two preceding years and also with either of these years considered separately.

I have added to the table for 1878 a column showing the mean dates for these three years, which I propose to continue and revise in future reports, so that we may in time arrive at some idea as to the mean dates for the county of the flowering of the plants observed. This column is compiled by taking in each year the earliest date recorded at whatever locality this date may apply to. For instance, in the present table, taking for illustration the first three plants enumerated, for the first the 8th of March is the date adopted, for the second the 21st of February, and for the third the 17th of April, these dates being those on which the flowers of the wood anemone, the lesser celandine, and the upright crowfoot respectively were first observed to be open in the county, though not each at the same locality. The dates for the preceding years are similarly taken, and then for each species each day of the month thus arrived at is converted into the day of the year, and this is divided by the number of years of observation, the mean thus found being finally re-converted into the day of the month. This is necessary to be done, because in different years the dates for any species may not occur in the same month of the year.

Of the 26 species of insects and birds, etc., in the list, 17 have been observed during the year, a considerable increase on the number observed in either of the two previous years. The record of these observations is now given in the same form as before. The initials used refer to the observers whose names have already been given.

* 'Trans. Watford Nat. Hist. Soc.,' Vol. I, p. 36.

† *Id.* Vol. II, p. 102.

74. *Apis Mellifica* (honey-bee). Seen at St. Albans, Jan. 1—C. M. P.; Watford, Jan. 3—J. H.; Ware, Jan. 6—R. B. C.; Odsey, Feb. 17—H. G. F.
75. *Pieris Brassice* (large white cabbage butterfly). Seen at Watford, April 25—J. H.
76. *Pieris Rapæ* (small white cabbage butterfly). Seen at Watford, April 11—J. H.; St. Albans, April 12—C. M. P.; Harpenden, April 12—J. J. W.; Hertford, April 15—R. T. A.
80. *Strix Aluco* (brown owl). Hooted at Ware, March 14—R. B. C.
81. *Muscicapa grisola* (flycatcher). Seen at Odsey, May 17—H. G. F.
82. *Turdus musicus* (song-thrush). Heard at Ware, Jan. 4—R. B. C.; St. Albans, Jan. 6—C. M. P.
83. *Turdus pilaris* (fieldfare). Seen at Ashwell, Oct. 29—H. G. F.
84. *Daulias Luscinia* (nightingale). Heard at St. Albans, April 12—C. M. P.; Ware, April 14—G. H. Gisby; Watford, April 15—J. King; April 17—Miss Wilson; Redbourn, April 18—George Willshin; Harpenden, April 18—J. J. W. Odsey, April 19—H. G. F.; Hunton Bridge, April 20—J. E. L.; King's Langley, April 21—J. E. L.; Ware, April 22—R. B. C.
86. *Phylloscopus Trochilus* (willow wren). Heard at Ware, March 1—R. B. C.
87. *Phylloscopus collybita* (chiff-chaff). Seen at Hunton Bridge, March 27—J. E. L.; Chipperfield, March 29—J. E. L.
88. *Alauda arvensis* (sky-lark). Heard at Ware, Jan. 27—R. B. C.; St. Albans, Feb. 18—C. M. P.; Harpenden, April 26—J. J. W.
90. *Corvus frugilegus* (rook). Building at St. Albans, Feb. 13—C. M. P.
91. *Cuculus canorus* (cuckoo). Heard at St. Albans, April 17—C. M. P.; Hertford, April 17—R. T. A.; Redbourn, April 18—G. Willshin; Sandon, April 19—H. G. F.; Watford, April 21—J. King; April 24—Dr. Brett; Cassiobury, April 22—Lord Essex; Ware, April 22—R. B. C.; Harpenden, April 25—J. J. W.; Odsey, April 25—H. G. F.
92. *Hirundo rustica* (swallow). Seen at Hunton Bridge, April 9—J. E. L.; Hemel Hempstead, April 11—J. E. L.; Watford, April 12—J. King; Ware, April 15—R. B. C.; April 17—G. H. Gisby; St. Albans, April 18—C. M. P.; Harpenden, April 19—J. J. W.; Essendon, April 19—G. H. Gisby; Ware, April 20—R. B. C.; Sandon, April 20—H. G. F.; St. Albans, April 22—C. M. P.; Odsey, April 28—H. G. F. Last seen at Odsey, Oct. 4—H. G. F.
93. *Cypselus Apus* (swift). Seen at King's Langley, May 5—J. E. L.; St. Albans, May 5—C. M. P.; Ware, May 9—R. B. C.; Odsey, May 12—H. G. F.
96. *Scolopax Rusticola* (woodcock). Seen at Abbot's Hill, Hemel Hempstead, Nov. 8—Rev. H. R. Pecl.
97. *Rana temporaria* (common frog). Spawn seen at Harpenden, March 4—J. J. W.; Ware, March 19—R. B. C.

Selecting from these the phenomena noticed also in 1876 and 1877, we find that the nightingale and cuckoo were first heard in the county from one to eight days earlier than in those years, that the swallow and swift were seen from ten to fifteen days earlier, and that frog spawn was seen about a month earlier. The remaining species observed in the three years, the lark, was heard earlier than in 1877, but later than in 1876.

These records therefore—all at least but the last, and that if one year is excepted—fully bear out the conclusion before arrived at from the evidence afforded by the plants observed; and it is satisfactory to find that the climatic conditions which retard or accelerate the growth and development of vegetable life affect the animal world in an analogous manner, causing birds to arrive earlier or later at their accustomed haunts, and amphibians, as evidenced by the frog, to vary the time of the events necessary for the existence of their species.

HERTFORDSHIRE NATURALISTS' CALENDAR.

No.	SPECIES.	MEAN, 1876-8.	
82.	Song Thrush (<i>Turdus musicus</i>) sg.....	2	Jan. 1
53.	Ivy-leaved Speedwell (<i>Veronica hederifolia</i>) fl.....	1	— 12
70.	Snowdrop (<i>Galanthus nivalis</i>) fl.....	2	— 20
66.	Hazel (<i>Corylus Avellana</i>) fl.....	1	— 25
74.	Honey Bee (<i>Apis mellifica</i>) ap.	2	— 26
88.	Skylark (<i>Alauda arvensis</i>) sg.....	2	— 31
89.	Chaffinch (<i>Fringilla cœlebs</i>) sg.	0	—
64.	Wych Elm (<i>Ulmus montana</i>) fl.....	2	Feb. 20
9.	Sweet Violet (<i>Viola odorata</i>) fl.....	3	— 25
37.	Coltsfoot (<i>Tussilago Farfara</i>) fl.....	3	— 25
63.	Dog's Mercury (<i>Mercurialis perennis</i>) fl.....	3	— 25
2.	Pilewort (<i>Ranunculus Ficaria</i>) fl.	3	— 26
69.	Daffodil (<i>Narcissus Pseudo-narcissus</i>) fl.....	2	— 26
8	Whitlow-grass (<i>Draba verna</i>) fl.....	1	— 27
6.	Hairy Bittercress (<i>Cardamine hirsuta</i>) fl.	0	—
86.	Willow Wren (<i>Phylloscopus Trochilus</i>) sg.....	1	March 1
36.	Butter-bur (<i>Petasites vulgaris</i>) fl.	1	— 2
65.	Great Sallow (<i>Salix caprea</i>) fl.	1	— 4
22.	Blackthorn (<i>Prunus spinosa</i>) fl.....	3	— 11
25.	Barren Strawberry (<i>Potentilla Fragariastrum</i>) fl.....	2	— 13
80.	Tawny Owl (<i>Strix Aluco</i>) hoots.....	1	— 14
90.	Rook (<i>Corvus frugilegus</i>) builds	3	— 14
61.	Cowslip (<i>Primula veris</i>) fl.	3	— 15
1.	Wood Anemone (<i>Anemone nemorosa</i>) fl.....	3	— 18
4.	Marsh Marigold (<i>Calltha palustris</i>) fl.	3	— 19
87.	Chiff-chaff (<i>Phylloscopus collybita</i>) sg.	2	— 20
97.	Common Frog (<i>Rana temporaria</i>) spawns.....	3	— 22
57.	Ground Ivy (<i>Nepeta Glechoma</i>) fl.....	3	— 26
12.	Greater Stitchwort (<i>Stellaria Holostea</i>) fl.....	3	— 29
30.	Wild Chervil (<i>Anthriscus sylvestris</i>) fl.....	3	April 9
76.	Small White Butterfly (<i>Pieris Rapæ</i>) ap.....	2	— 10
7.	Cuckoo Flower (<i>Cardamine pratensis</i>) fl.	3	— 11
84.	Nightingale (<i>Daulias Luscinia</i>) sg.....	3	— 15
92.	Swallow (<i>Hirundo rustica</i>) first seen.....	3	— 18
91.	Cuckoo (<i>Cuculus canorus</i>) first heard	3	— 19
62.	Ribwort (<i>Plantago lanceolata</i>) fl.....	3	— 20
71.	Blue-bell (<i>Endymion nutans</i>) fl.....	3	— 21
3.	Upright Crowfoot (<i>Ranunculus acris</i>) fl.	3	— 26
16.	Herb Robert (<i>Geranium Robertianum</i>) fl.	3	— 26
52.	Germander Speedwell (<i>Veronica Chamædrys</i>) fl.	3	— 26
75.	Large White Butterfly (<i>Pieris Brassicæ</i>) ap.....	2	— 27
78.	St. Mark's Fly (<i>Bibio Marci</i>) ap.	0	—
60.	Creeping Bugle (<i>Ajuga reptans</i>) fl.....	3	May 3
20.	Bush Vetch (<i>Vicia sepium</i>) fl.....	3	— 4
51.	Red Rattle (<i>Pedicularis sylvatica</i>) fl.....	1	— 5
94.	Turtle Dove (<i>Columba Turtur</i>) first seen	0	—
93.	Swift (<i>Cypselus Apus</i>) first seen.....	3	— 12
72.	Cock-chaffer (<i>Melolontha vulgaris</i>) ap.	0	—
10.	Milkwort (<i>Polygala vulgaris</i>) fl.....	3	— 19
81.	Flycatcher (<i>Muscicapa grisola</i>) first seen	2	— 19

HERTFORDSHIRE NATURALISTS' CALENDAR (*continued*).

No.	SPECIES.	MEAN, 1876-8.	
32.	Cleavers (<i>Galium aparine</i>) fl.	3	May 20
17.	Dutch Clover (<i>Trifolium repens</i>) fl.	3	— 22
24.	Silver-weed (<i>Potentilla anserina</i>) fl.	3	— 23
50.	Comfrey (<i>Symphytum officinale</i>) fl.	1	— 23
39.	Ox-eye (<i>Chrysanthemum Leucanthemum</i>) fl.	3	— 25
46.	Mouse-ear (<i>Hieracium pilosella</i>) fl.	3	— 25
18.	Bird's-foot Trefoil (<i>Lotus corniculatus</i>) fl.	3	— 26
5.	Red Poppy (<i>Papaver Rhœas</i>) fl.	3	— 27
11.	Ragged Robin (<i>Lychnis Flos-cuculi</i>) fl.	3	June 3
68.	Yellow Iris (<i>Iris Pseudacorus</i>) fl.	3	— 3
26.	Dog Rose (<i>Rosa canina</i>) fl.	3	— 5
67.	Spotted Orchis (<i>Orchis maculata</i>) fl.	3	— 5
59.	Hedge Woundwort (<i>Stachys sylvatica</i>) fl.	3	— 6
13.	Common Mallow (<i>Malva sylvestris</i>) fl.	3	— 8
21.	Meadow Vetchling (<i>Lathyrus pratensis</i>) fl.	3	— 8
73.	Fern-chafer (<i>Rhizotrogus solstitialis</i>) ap.	0	—
95.	Partridge (<i>Perdix cinerea</i>) hatches.	0	—
77.	Meadow-brown Butterfly (<i>Epinephile Janira</i>) ap.	1	— 11
28.	Broad Willow-herb (<i>Epilobium montanum</i>) fl.	2	— 12
55.	Wild Thyme (<i>Thymus Serpyllum</i>) fl.	2	— 14
91.	Cuckoo (<i>Cuculus canorus</i>) changes its note	1	— 14
43.	Spear Thistle (<i>Carduus lanceolatus</i>) fl.	1	— 16
56.	Self-heal (<i>Prunella vulgaris</i>) fl.	1	— 17
23.	Meadow-sweet (<i>Spiræa Ulmaria</i>) fl.	2	— 20
42.	Black Knapweed (<i>Centaurea nigra</i>) fl.	2	— 21
38.	Milfoil (<i>Achillea Millefolium</i>) fl.	3	— 23
15.	Upright St. John's Wort (<i>Hypericum pulchrum</i>) fl.	1	— 25
19.	Tufted Vetch (<i>Vicia Cracca</i>) fl.	2	— 27
58.	Hemp Nettle (<i>Galeopsis tetrahit</i>) fl.	1	— 27
33.	Yellow Bedstraw (<i>Galium verum</i>) fl.	3	— 30
41.	Ragwort (<i>Senecio Jacobæa</i>) fl.	3	July 1
44.	Field Thistle (<i>Carduus arvensis</i>) fl.	3	— 3
27.	Great Hairy Willow-herb (<i>Epilobium hirsutum</i>) fl.	1	— 7
45.	Corn Sow-thistle (<i>Sonchus arvensis</i>) fl.	1	— 7
47.	Hair-bell (<i>Campanula rotundifolia</i>) fl.	3	— 8
49.	Greater Bindweed (<i>Convolvulus sepium</i>) fl.	1	— 2
85.	Wheatear (<i>Saxicola Enanthe</i>) returns	0	—
14.	Square St. John's Wort (<i>Epilobium tetrapterum</i>) fl.	1	— 10
29.	Wild Angelica (<i>Angelica sylvestris</i>) fl.	0	—
34.	Common Teasel (<i>Dipsacus sylvestris</i>) fl.	0	—
40.	Mugwort (<i>Artemisia vulgaris</i>) fl.	1	August 8
92.	Swallow (<i>Hirundo rustica</i>) begins to flock.	0	—
35.	Devil's-bit (<i>Scabiosa succisa</i>) fl.	1	— 16
48.	Autumn Gentian (<i>Gentiana Amarella</i>) fl.	0	—
54.	Water Mint (<i>Mentha aquatica</i>) fl.	0	—
87.	Chiff-chaff (<i>Phylloscopus collybita</i>) last heard	0	Sept.
31.	Ivy (<i>Hedera Helix</i>) fl.	2	Oct. 10
83.	Fieldfare (<i>Turdus pilaris</i>) arrives	2	Nov. 2
96.	Woodcock (<i>Scolopax Rusticola</i>) first seen	1	— 8
79.	Winter Gnat (<i>Trichocera hiemalis</i>) ap.	1	Dec. 25

By the method of deducing the mean dates of phenological phenomena previously explained, I propose to compile our Naturalists' Calendar for Hertfordshire, a first instalment of which, including the results of observation of insects and birds as well as of plants, is given in the second table accompanying this report (pp. 234, 235).^{*} The comparative value of the dates given is shown in this table by an additional column of figures (0 to 3) giving the number of years each species has been observed. This calendar may also be of practical use to our observers as showing when to look out for the occurrences of which a record is desired. For this purpose I have inserted in their most probable position the phenomena of which no record has yet been received, as, if they were omitted altogether from the calendar, they would be likely to be overlooked in future years. I have ventured to substitute the autumn gentian for the field gentian, as we should never get observations of the latter, and may possibly do so of the former, which is of much more frequent occurrence in the county. The two species are very nearly allied and they open their flowers at about the same time. The autumn gentian is the one which has hitherto been most generally observed. It appears in both White's[†] and Jenyns'[‡] Calendars, whilst the field gentian is not given in either, and it is therefore not only the species which is the most likely to be observed in Hertfordshire, but is also the one of which we have published records available for comparison.

^{*} The following abbreviations are used in this table:—fl.—flowers open; ap.—first appears; sg.—song commences.

[†] 'Natural History of Selborne.'

[‡] 'Observations in Natural History.'

31.—REMARKS ON THE WINTER OF 1878-79.

By WILLIAM MARRIOTT, F.M.S.

Communicated by J. HOPKINSON, Hon. Sec.

[Read 13th May, 1879.]

THE recent Winter and Spring have been of such an exceptional character that a few brief notes on their leading features may not be without interest.

The accompanying Table gives the average daily temperature as deduced from 60 years' observations (1814-1873) at the Royal Observatory, Greenwich,* and the mean temperature for each day from October 1st, 1878, to May 31st, 1879,† together with its departure from the average.

From this table it will be seen that the cold weather commenced on October 27th, and continued with two or three exceptions till Christmas Day. The cold was excessively intense from December 6th to 25th, during which period the temperature was more than 10° below the average on eleven occasions, and did not rise to the freezing-point on fifteen days; the lowest mean temperature being $20^{\circ}\cdot 8$, or $17^{\circ}\cdot 4$ below the average, on December 24th. The minimum temperatures were registered at most places during the evening of December 24th or the morning of the 25th. The lowest readings that I have been able to obtain were on the 13th,— $2^{\circ}\cdot 0$ at Gainford, 8 miles W. of Darlington; on the 24th, $2^{\circ}\cdot 5$ at Buxton; and on the 25th,— $1^{\circ}\cdot 0$ at Gainford, $4^{\circ}\cdot 8$ at Cheltenham and Hereford, and $6^{\circ}\cdot 9$ at Hillington. At Watford $8^{\circ}\cdot 8$ was registered on the 25th.

During the early part of December the air was very damp, the moisture being copiously deposited upon trees, etc., in the form of a beautiful coating of hoar-frost. Fog and mist were also prevalent, and snow fell frequently during the month, the drifts in some places being so deep that railway communication was entirely suspended.

A sudden change set in on December 26th and continued to January 1st, during which period the weather was very mild and rough, affording a marked contrast to that which had previously prevailed.

On January 2nd the frost again returned, and continued with the exception of the 13th, 14th, and 15th, to February 5th. January 10th, 11th, and 12th were especially cold, the mean temperature on these days being more than 10° below the average. The wind during this period blew generally from the E. and N.E., and was strong in force. Owing to the keen dry E. wind the grass in many places had the appearance of being scorched or burnt.

* By J. Glaisher, F.R.S., 'Quarterly Journal of the Meteorological Society,' vol. iii, p. 317.

† Extended, after the reading of the paper, to this date.

TABLE showing the average daily Temperature of the 60 years 1814-73, and the mean temperature from October 1st, 1878, to January 31st, 1879, with the departure from average, at the Royal Observatory, Greenwich.

Date.	OCTOBER.			NOVEMBER.			DECEMBER.			JANUARY.		
	Average of 60 years.	Daily mean 1878.	Departure from Average.	Average of 60 years.	Daily mean 1878.	Departure from Average.	Average of 60 years.	Daily mean 1878.	Departure from Average.	Average of 60 years.	Daily mean 1879.	Departure from Average.
	°	°	°	°	°	°	°	°	°	°	°	°
1	54.4	52.8	-1.6	46.2	42.5	-3.7	41.7	36.5	-5.2	37.2	42.1	+4.9
2	54.2	49.9	-4.3	46.0	39.8	-6.2	41.8	37.4	-4.4	36.9	29.5	-7.4
3	53.9	57.4	+3.5	45.8	38.0	-7.8	41.8	36.9	-4.9	36.7	38.4	+1.7
4	53.5	56.6	+3.1	45.6	37.3	-8.3	41.8	37.8	-4.0	36.6	33.3	-3.3
5	53.2	61.3	+8.1	45.4	40.5	-4.9	41.7	38.1	-3.6	36.5	30.5	-6.0
6	52.9	61.0	+8.1	45.1	40.3	-4.8	41.6	32.9	-8.7	36.4	27.2	-9.2
7	52.6	61.7	+9.1	44.7	38.7	-6.0	41.5	34.5	-7.0	36.3	30.6	-5.7
8	52.2	59.1	+6.9	44.3	39.2	-5.1	41.4	32.7	-8.7	36.2	30.5	-5.7
9	51.9	58.5	+6.6	43.9	37.5	-6.4	41.2	30.2	-11.0	36.2	29.9	-6.3
10	51.6	56.8	+5.2	43.5	45.1	+1.6	41.0	26.7	-14.3	36.3	24.7	-11.6
11	51.3	51.2	-0.1	43.2	39.5	-3.7	40.8	30.0	-10.8	36.3	24.2	-12.1
12	51.0	50.0	-1.0	42.9	35.1	-7.8	40.7	27.1	-13.6	36.4	26.3	-10.1
13	50.7	50.2	-0.5	42.7	36.9	-5.8	40.6	25.8	-14.8	36.4	41.8	+5.4
14	50.4	51.7	+1.3	42.5	40.7	-1.8	40.7	26.2	-14.5	36.5	42.4	+5.9
15	50.2	52.0	+1.8	42.3	39.9	-2.4	40.7	29.8	-10.9	36.6	39.2	+2.6
16	50.0	53.5	+3.5	42.2	41.7	-0.5	40.7	31.4	-9.3	36.7	33.0	-3.7
17	49.8	51.2	+1.4	42.0	42.7	+0.7	40.5	28.0	-12.5	36.8	32.3	-4.5
18	49.7	51.6	+1.9	41.9	42.9	+1.0	40.2	34.6	-5.6	36.9	33.1	-3.8
19	49.5	53.2	+3.7	41.8	40.8	-1.0	40.0	34.9	-5.1	37.0	31.6	-5.4
20	49.3	54.3	+5.0	41.7	40.6	-1.1	39.7	30.2	-9.5	37.2	28.4	-8.8
21	49.0	57.9	+8.9	41.7	40.2	-1.5	39.3	29.6	-9.7	37.3	27.9	-9.4
22	48.7	48.3	-0.4	41.7	39.1	-2.6	38.8	29.9	-8.9	37.4	28.4	-9.0
23	48.3	47.7	-0.6	41.7	37.8	-3.9	38.4	26.0	-12.4	37.5	28.1	-9.4
24	47.9	49.7	+1.8	41.6	42.8	+1.2	38.2	20.8	-17.4	37.7	29.4	-8.3
25	47.5	47.9	+0.4	41.6	46.2	+4.6	38.0	26.6	-11.4	37.8	30.6	-7.2
26	47.2	46.5	-0.7	41.6	39.6	-2.0	37.8	42.2	+4.4	37.9	32.9	-5.0
27	46.9	43.6	-3.3	41.6	37.7	-3.9	37.6	40.7	+3.1	38.1	33.5	-4.6
28	46.7	43.8	-2.9	41.6	39.9	-1.7	37.5	42.4	+4.9	38.2	31.5	-6.7
29	46.6	40.7	-5.7	41.7	33.3	-8.4	37.4	43.2	+5.8	38.3	32.0	-6.3
30	46.5	37.3	-9.2	41.7	33.8	-7.9	37.3	52.1	+14.8	38.4	31.5	-6.9
31	46.4	39.2	-7.2	.....	.....	.....	37.2	51.0	+13.8	38.5	30.7	-7.8
Means	50.1	51.5	+1.4	43.0	39.7	-3.3	39.9	33.7	-6.2	37.1	31.8	-5.3

TABLE showing the average daily Temperature of the 60 years 1814-73, and the mean temperature from February 1st, 1879, to May 31st, with the departure from average, at the Royal Observatory, Greenwich.

Date.	FEBRUARY.			MARCH.			APRIL.			MAY.		
	Average of 60 years.	Daily mean 1879.	Departure from Average.	Average of 60 years.	Daily mean 1879.	Departure from Average.	Average of 60 years.	Daily mean 1879.	Departure from Average.	Average of 60 years.	Daily mean 1879.	Departure from Average.
1	38.6	28.9	— 9.7	40.3	38.0	— 2.3	44.2	45.7	+ 1.5	49.8	41.1	— 8.7
2	38.7	35.0	— 3.7	40.4	38.3	— 2.1	44.4	44.0	— 0.4	50.1	42.5	— 7.6
3	38.8	34.9	— 3.9	40.5	39.7	— 0.8	44.6	41.2	— 3.4	50.4	43.6	— 6.8
4	38.9	33.9	— 5.0	40.5	41.4	+ 0.9	44.8	45.1	+ 0.3	50.8	44.0	— 6.8
5	39.0	34.7	— 4.3	40.5	48.4	+ 7.9	44.9	46.8	+ 1.9	51.2	51.7	+ 0.5
6	39.1	45.9	+ 6.8	40.5	43.9	+ 3.4	45.0	46.3	+ 1.3	51.6	42.5	— 9.1
7	39.1	46.9	+ 7.8	40.5	41.1	+ 0.6	45.2	51.5	+ 6.3	51.7	39.6	— 12.1
8	39.1	47.2	+ 8.1	40.5	42.0	+ 1.5	45.4	49.7	+ 4.3	51.6	40.1	— 11.5
9	39.1	49.9	+ 10.8	40.5	46.6	+ 6.1	45.6	46.7	+ 1.1	51.5	42.9	— 8.6
10	39.0	47.4	+ 8.4	40.6	44.3	+ 3.7	45.7	38.9	— 6.8	51.3	40.6	— 10.7
11	39.0	46.4	+ 7.4	40.7	44.5	+ 3.8	45.8	34.5	— 11.3	51.2	43.1	— 8.1
12	38.9	39.2	+ 0.3	40.8	44.6	+ 3.8	45.9	33.2	— 12.7	51.1	51.3	+ 0.2
13	38.9	40.0	+ 1.1	41.0	36.6	— 4.4	46.1	38.4	— 7.7	51.1	50.1	— 1.0
14	38.8	44.5	+ 5.7	41.2	34.5	— 6.7	46.3	37.5	— 8.8	51.3	50.1	— 1.2
15	38.7	39.0	+ 0.3	41.4	43.4	+ 2.0	46.5	44.7	+ 1.8	51.7	44.2	— 7.5
16	38.7	38.8	+ 0.1	41.5	46.2	+ 4.7	46.6	38.7	— 7.9	52.3	47.0	— 5.3
17	38.7	36.2	— 2.5	41.6	40.1	— 1.5	46.8	39.5	— 7.3	52.8	49.7	— 3.1
18	38.8	35.6	— 3.2	41.7	45.0	+ 3.3	47.0	39.8	— 7.2	53.2	49.6	— 3.6
19	38.8	38.4	— 0.4	41.7	50.6	+ 8.9	47.2	42.0	— 5.2	53.6	53.1	— 0.5
20	38.9	37.2	— 1.7	41.7	46.8	+ 5.1	47.4	43.9	— 3.5	53.7	55.6	+ 1.9
21	39.0	33.2	— 5.8	41.8	41.1	— 0.7	47.6	40.1	— 7.5	53.9	57.4	+ 3.5
22	39.1	31.5	— 7.6	41.9	35.4	— 6.5	47.8	42.1	— 5.7	54.1	56.8	+ 2.7
23	39.2	31.7	— 7.5	42.0	33.1	— 8.9	48.0	46.3	— 1.7	54.3	48.2	— 6.1
24	39.3	30.2	— 9.1	42.1	30.6	— 11.5	48.2	44.8	— 3.4	54.6	55.4	+ 0.8
25	39.5	33.3	— 6.2	42.3	30.9	— 11.4	48.3	46.2	— 2.1	55.0	51.2	— 3.8
26	39.7	33.5	— 6.2	42.5	33.3	— 9.2	48.5	49.6	+ 1.1	55.2	49.4	— 5.8
27	39.9	34.5	— 5.4	42.7	36.0	— 6.7	48.7	47.7	— 1.0	55.4	51.3	— 4.1
28	40.1	42.6	+ 2.5	43.0	37.1	— 5.9	48.9	43.9	— 5.0	55.6	52.0	— 3.6
29	.....	.....	.....	43.3	47.2	+ 3.9	49.1	44.2	— 4.9	55.8	52.5	— 3.3
30	.....	.....	.....	43.7	46.6	+ 2.9	49.4	44.4	— 5.0	56.0	52.7	— 3.3
31	.....	.....	.....	44.0	48.5	+ 4.5	.....	.....	.....	56.3	52.5	— 3.8
Means	39.0	38.2	— 0.8	41.5	41.2	— 0.3	46.6	43.2	— 3.4	52.9	48.4	— 4.5

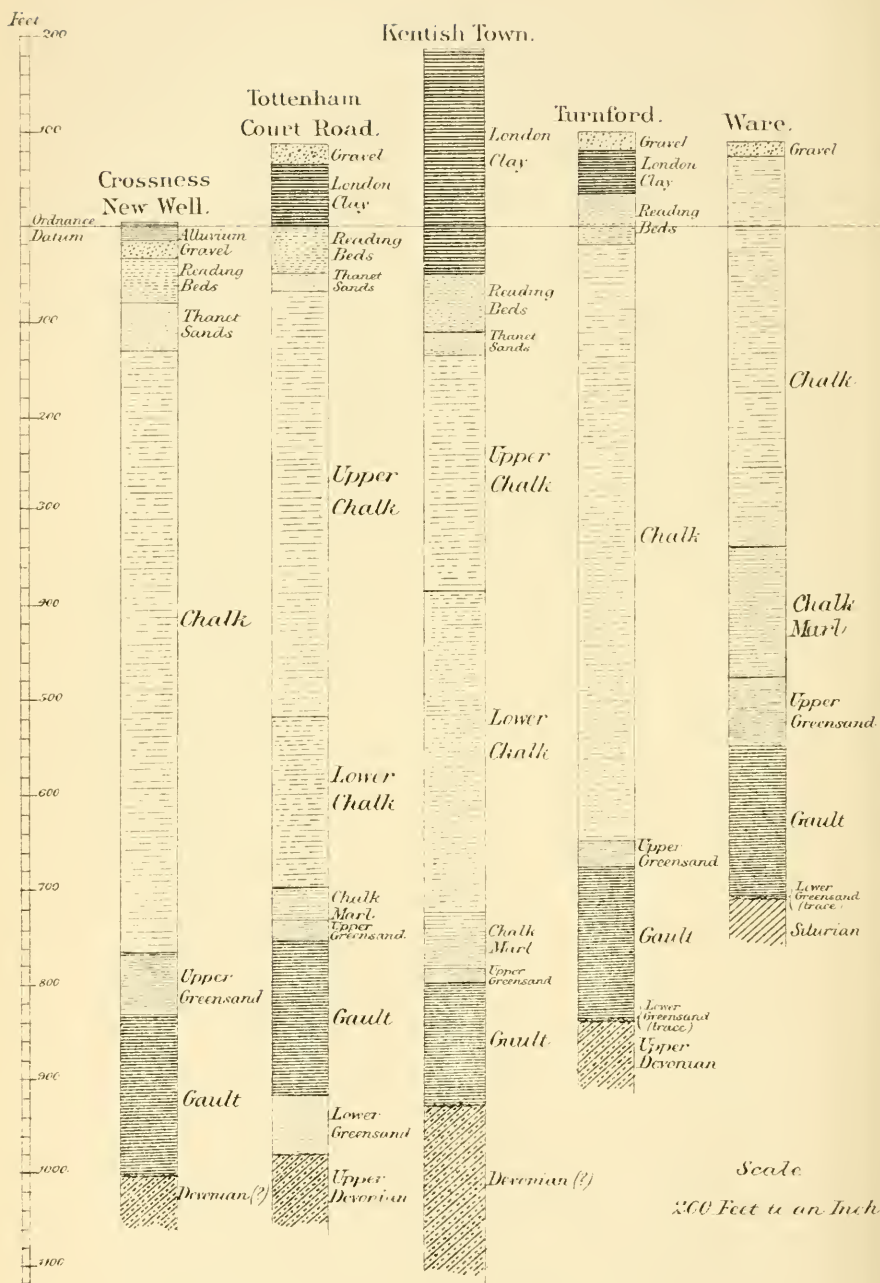
Rain, snow, and fog were less prevalent than in December, but the sky was so persistently covered with cloud, that the sun, moon, and stars were rarely visible.

Mild weather set in on February 6th, and continued to the 16th, during which period rain fell frequently, accompanied with S.W. winds. The temperature was cold again from the 17th to March 3rd, with N. winds, frequent snow, and fog. During March, and to April 9th, the weather was changeable, short cold and mild periods alternating with each other; that from the 22nd to the 28th being very cold, with snow and winds from the N.E.

During the remainder of April and the whole of May, the weather, with a few slight exceptions, was very cold, on some occasions the temperature being more than 10° below the average. Snow fell on several days, and as recently as May 10th. The fall on May 1st was between 2 and 3 feet at Swindon.

The Winter and Spring have been remarkable, not so much for the low temperature, as for its *long continuance*. This abnormal condition, and the prevalence of N. to E. winds, were due to the usual distribution of atmospheric pressure being reversed, the highest persistently held to the north of these islands, while the lowest was over France and the South of Europe.

The cold weather has greatly retarded the growth of vegetation, everything being fully a month behind the usual time.



WELL-SECTIONS IN THE LONDON BASIN
REACHING PALÆOZOIC ROCKS.

32.—ON THE RECENT DISCOVERY OF SILURIAN ROCKS IN HERTFORDSHIRE, AND THEIR RELATION TO THE WATER-BEARING STRATA OF THE LONDON BASIN.

By JOHN HOPKINSON, F.L.S., F.G.S., etc., Hon. Sec.

[Read 12th June, 1879.]

PLATE II.

SEVERAL deep borings have at various times been made in the neighbourhood of London, within the area known to geologists as the "London Basin," principally with the object of obtaining a large supply of water from water-bearing strata in or below the Chalk. From these borings valuable information has been gained as to the conditions in which the series of rocks underlying the London area occur in their extension beneath the surface, where they have been found to differ considerably in their nature, thickness, etc., from their prevailing character where they "crop out" or appear on the surface round the edges of the basin. Important discoveries have also resulted from some of the deeper borings,—discoveries which, though almost anticipated by geological induction, have opened up, as will presently be seen, a new field of investigation and study. Of these, one of the most interesting is the discovery of rocks of Silurian age in our own county, at the New River Company's boring near Ware,—a discovery which throws new light upon the relations of the older rocks which other recent borings have shown to underlie the London Basin.

The main features of this London Basin, and the most interesting points connected with it, both physical and palæontological, are probably well known to the members of this Society, from the valuable lectures we have had from Professor Morris* and Mr. Lobley;† and the principal member of this basin, the Chalk, has been fully treated of, as a water-bearing formation, by the Rev. J. C. Clutterbuck‡ and Mr. John Evans.§ I will therefore avoid, as far as possible, the ground thus so ably occupied. I may, however, recall to you the explanation of the structure of the London Basin given by Professor Morris,|| by pointing out that the section here given¶ represents a series of strata which were originally deposited horizontally, and which have afterwards, by the sinking of the

* "The Physical Structure of the London Basin, considered in its Relation to the Geology of the Neighbourhood of Watford." 'Transactions,' Vol. I. p. 89.

† "The Cretaceous Rocks of England." *Ib.* p. 1. "The Eocenes of England and their Extension in Hertfordshire." *Ib.* p. 161.

‡ "The Geology and Water-supply of the Neighbourhood of Watford." *Ib.* p. 125.

§ "The Hertfordshire Bourne." *Ib.* p. 137.

|| 'Transactions,' Vol. I, p. 91.

¶ This section was drawn on the black board. See 'Transactions,' Vol. I, p. 11, for a somewhat similar section, differing chiefly in not showing the Palæozoic ridge.

central area or the rising of the strata forming or supporting the sides of the basin, most probably from lateral pressure, assumed their present basin-shaped form.

These strata vary much in their pervious nature, some of the beds, as the London Clay, being almost impermeable, and others, as the Lower Greensand, containing bands of loose porous sands through which water can easily percolate. It will be at once seen that if we have, for instance, a bed of sand between two beds of clay in a basin-shaped form, the rain falling on the surface (excepting the portion which evaporates or is absorbed by vegetation, etc.) will run off the clay on which it falls, but will percolate into the sand, which will form a reservoir in which a great part of the rain falling over the entire area will accumulate. If now we sink a well through the top bed of clay into the sand, the water will rise to the height of the edge of the bottom bed of clay. If, however, we suppose that the sand does not form a continuous layer between the two beds of clay, which at some part of the basin are in juxtaposition, at such part it would be useless to sink a well; but this circumstance would not interfere with the water-bearing value of the bed of sand where present, except by diminishing its area and thus reducing its capacity as a reservoir. The knowledge of the position and extent of the underground area devoid of the bed of sand must therefore be of the utmost importance, for all attempts to obtain water in this area would be futile. The problem is but a little more complicated, if we imagine that, where the sand is absent, the lower bed of clay is also wanting, and that in that part of the basin there is some other rock present not of a water-bearing nature. The bed of sand has still the same value as an underground reservoir, and the problem is now to determine the position and extent of this rock which takes the place which would have been occupied by the bed of sand, and its bottom bed of clay, had these beds been continuous.

Such is, in its simplest form, the problem which is gradually being solved by these deep borings, so far as the search in the London area for a large supply of pure water is concerned.

The bed of clay on which London is situated, here and there capped by beds of gravel and sand, from which a limited supply of water was at one time obtained (now contaminated by surface drainage), reposes on a series of beds of sands and clays from which some amount of water is even now here and there derived; these two series of strata being known as the London Clay and the Woolwich and Reading Beds. The Chalk then follows in regular succession, and from its somewhat porous nature and its numerous fissures and hollows usually filled with water, forms a valuable water-bearing formation; but its area is limited, and the water it holds is what is called "hard," holding in solution a considerable per-centage of calcareous matter. The Chalk passes almost imperceptibly into a softer bed called the Chalk Marl, and this again reposes on a bed called the Upper Greensand or Chloritic Marl, below which there is another bed of clay, the Gault, which from

its impervious nature forms as it were the bottom and embankments of the reservoir from which our principal underground supply of water is now obtained. We now come to the fourth underground reservoir in descending order, the Lower Greensand or Neocomian, which consists of a series of strata mostly siliceous but varying much in their nature, some existing as a hard rock, as the Kentish Rag, and others being loose, light-coloured porous sands, forming a valuable water-bearing stratum. On one side of our basin, the south, these beds are upheld by the impermeable clays of the Wealden series, and on another, the north, by the almost equally impermeable clays of the Jurassic series.

The earliest attempt to obtain a supply of water from this Lower Greensand formation, in the immediate neighbourhood of London, was made more than 25 years ago at a point just below the first rise of Highgate Hill, by the side of the road from Kentish Town, and the boring is known as the Kentish Town well. A well had been sunk by the Hampstead Waterworks Company to a depth of 539 feet, passing through $324\frac{1}{2}$ feet of Tertiary strata and $214\frac{1}{2}$ feet of the Chalk. The supply of water at that depth being insufficient, in June, 1853, a boring was commenced in the chalk at the bottom of the well, and when $430\frac{1}{2}$ feet of chalk had been passed through, giving to the Chalk a total thickness of 645 feet, the Upper Greensand was entered. This was found to be $13\frac{1}{2}$ feet thick, and to be underlaid by the Gault with a thickness of $130\frac{1}{2}$ feet, and with the usual layer of phosphatic nodules at its base. So far, to the total depth of $1113\frac{1}{2}$ feet, the strata were found to be in regular succession, and it had been anticipated that at this point the next bed in regular descending order, the Lower Greensand, would be entered. Such, however, was not the case. A series of beds of sandstones and clays, and a peculiar conglomerate, were passed through for $188\frac{1}{2}$ feet, making a total depth of 1302 feet. When this point was reached, the property came into the possession of the New River Company, and the boring was not carried to any greater depth. The geological age of the strata below the Gault could not be satisfactorily determined, owing to the method of boring rendering it uncertain whether the few fossils obtained from these beds were really derived from them or had fallen down the bore-hole from higher beds, a supposition which the fossils themselves favoured, being species which were only known to occur elsewhere in beds of Gault or Upper Greensand age. Mr. (now Professor) Prestwich inclined at the time to the opinion that in their mineral character the Kentish Town beds closely resembled the red marls of the New Red Sandstone group,* and subsequently came to the conclusion that they "should probably be referred to the Old Red Sandstone."†

* "On the Boring through the Chalk at Kentish Town, London." 'Quart. Journ. Geol. Soc.' vol. xii, p. 6.—1856. See also the paper by Mr. Prestwich "On the Boring through the Chalk at Harwich." *Ib.* vol. xiv, p. 251.—1858.

† 'Report of the Commissioners appointed to enquire into the several matters relating to Coal in the United Kingdom,' vol. i, p. 156.—1871.

That the geological sequence should be broken below the Gault was previously unsuspected by him. The Lower Greensand, cropping out both north and south of London, and skirting the Gault continuously, "from a surface examination of the ground there could be," he said, "no apparent reason for supposing that the same deposit was not continuous underground." * In a remarkable paper "On the Possible Extension of the Coal-Measures beneath the South-eastern Part of England," † communicated to the Geological Society whilst this boring was in progress, and before its unexpected results were made known, Mr. Godwin-Austen had, however, stated it as his opinion that an axis of Palæozoic rocks was prolonged from the Ardennes under the London Tertiary district, and that a band of Coal-measures coincided with the line of the valley of the Thames, where it might some day be reached.

The conclusion arrived at by Prof. Prestwich that the Kentish Town beds are of Old Red Sandstone age ‡ has been confirmed, or at least shown to be most probably correct, by a boring which has recently been made at Messrs. Meux & Co.'s brewery in Tottenham Court Road; and the opinion expressed twenty-five years ago by Mr. Godwin-Austen, that an axis of Palæozoic rocks passes under London, has at the same time been proved to be correct. In the artesian well at Messrs. Meux's, after passing through 156½ feet of Tertiary strata, 655½ feet of Chalk, 28 feet of the Upper Greensand, 160 feet of Gault, and 64 feet of Lower Greensand, a total depth of 1064 feet, beds of undoubted Upper Devonian age, as proved by their fossils, were met with, dipping under the Lower Greensand at an angle of 35 degrees. Unfortunately the direction of the dip, and therefore the direction of the strike of the beds, could not be ascertained. Rocks which from their mineral character are believed to be of Devonian age have also been met with, at a depth of 1008 feet, in a boring at Crossness, on the south bank of the Thames, below Blackwall. Detailed sections of these, and particulars of other recent borings, have been given by Professor Prestwich in a paper on the Tottenham Court Road well-section read before the Geological Society about twelve months ago.§

For the result arrived at from the Tottenham Court Road boring, we are indebted to the Diamond Rock Boring Company, or rather to their method of boring by means of diamonds. This method the members of our Society had an opportunity of becoming acquainted with last year at the New River Company's boring between Hertford and Ware. || At the date of our visit the boring had been carried to a depth of 250 feet, and cores of chalk about fifteen

* 'Quart. Journ. Geol. Soc.' vol. xii, p. 9. † *Ib.* p. 38.—1856.

‡ The term Old Red Sandstone is here used as synonymous with that of Devonian.

§ "On the Section of Messrs. Meux & Co.'s Artesian Well in the Tottenham Court Road, with Notices of the Well at Crossness, and of another at Shoreham, Kent; and on the probable Range of the Lower Greensand and Palæozoic Rocks under London." *Ib.* vol. xxxiv, p. 902.—1878.

|| See 'Transactions,' Vol. I, p. xxviii.

inches in diameter, and sometimes some feet in length, were being brought up. The diamonds, as we then saw, are set in rows tangentially at the bottom of a ring called the "crown," which, being made to revolve while pressed down from above, cuts a circle out of the rock in which it is working, leaving within the circle cut away a solid column or "core" of the rock. This core, when of a certain length, varying according to the diameter of the crown used, and the hardness of the rock, is brought up entire. It therefore gives a perfectly true section of the stratum from which it is taken, and allows of the angle of bedding or "dip," but not its direction, being accurately determined, and of the fossils in the rock-masses brought up being obtained and identified as readily as if they were taken from an open section. In a letter which appeared in the 'Times' about three weeks ago (19th May, 1879), Mr. Robert Etheridge, F.R.S. (whom we have this evening elected an honorary member of our Society), made known the most important discovery in this boring of rocks of the age of the Wenlock Shale. This letter has also appeared in the 'Geological Magazine,'* and in our county newspapers.

Since this discovery was thus made known I have paid another visit to the boring, and by the courtesy of Mr. Wild, the Resident Engineer, I am enabled to give a general section, which is as follows:—Gravel, 14 feet; Chalk, 416 feet; Chalk Marl, 128 feet; Upper Greensand, 77 feet; Gault, 160 feet; giving a total depth to the base of the Gault of 795 feet.† At this point I am informed by Mr. Etheridge that there is a trace of the "Car Stone" of the Lower Greensand formation. At the time of my visit—the week before last—43 feet of the Wenlock Shale, with thin intercalated bands of limestone, had been passed through, this formation, as announced by Mr. Etheridge, having been found to underlie the Gault. The dip of the Cretaceous rocks is very slight (scarcely perceptible); that of the underlying Silurian rocks is on the contrary very great, being 40 degrees. A few pieces of shale I brought away show a sufficient number of fossils to prove that the deposit in which they occur is of Wenlock age.‡ The species are as follows:—*Periechoerinus*, sp. (a Crinoid); *Atrypa reticularis*, *Meristella tumida*, *Rhynchonella*, sp., *Strophomena depressa*, *S. Euglypha*, and *S. rhomboidalis* (Brachiopoda); *Orthonota rigida*, and *Pterinæa*, sp. (Conchifera). Mr. Etheridge has also kindly lent me a few specimens for exhibition, including a Protozoon, *Ischadites Kænigi*, and a Trilobite, *Phacops caudatus*.

* Decade ii, vol. vi, p. 286.—1879.

† Too great a thickness seems to be assigned to the Chalk Marl and the Upper Greensand; but the passage from the Lower Chalk, through the Chalk Marl into the Upper Greensand, is here so gradual, that it is difficult to determine, from the cores brought up in boring, the precise points where the lines of division should be drawn. It is owing to the absence of information due to this cause that in some of the sections given in the plate illustrating this paper the Chalk is not divided into the Upper and Lower Chalk and Chalk Marl.

‡ The specimens were exhibited in the room.

We have, therefore, under the London Basin, an axis of Palæozoic rocks, two divisions of which have now been discovered, namely, the Upper Silurian and the Devonian. This axis has been inferred to be a prolongation eastwards of the Palæozoic ridge which skirts the coal-basin of South Wales, then forms the Mendip range, disappears under Secondary rocks near Frome, and, after passing under London and the south-east of England generally, is possibly, under somewhat different conditions, the same ridge which is known as the axis of the Ardennes. The rocks of which it is composed are presumably, from their known character in their prolongation east and west, much contorted, and within the folds of the Devonian rocks it is *possible* there may be beds of coal, for elsewhere Carboniferous strata, with productive coal-measures, accompany them in their contortions, to the extent, as in the Auchy-au-Bois coal-field, of actually underlying them; the Devonian being folded over the Carboniferous strata. The strike of the old rocks, between London and the Mendip Hills, would according to this view be due east and west. The fossils from the Silurian rocks of the Ware boring are, however, typical of the Wenlock shale as met with at Dudley and Wenlock Edge, seeming to show that the strike of the Silurian rocks at least is north-west and south-east, in which case we may have coal-beds on the northern flanks of this anticlinal, as well as on the southern in the synclinal trough, or within folds in the Devonians, between this axis and that of the Mendips and Ardennes to the south. The Ludlow rocks might be expected to occur under Hertford; and it would then become an interesting question as to whether the next series, occupying that part of the old land surface lying between Hertford and Kentish Town, would be, as at Messrs. Meux & Co.'s boring, marine Devonians of Devonshire and Cornwall type, or "Old Red" beds similar to those which succeed the Ludlow rocks in Herefordshire. It appears more likely that a coal-basin would lie to the south-west, if Old Red Sandstone beds of estuarine or lacustrine origin followed, than if the next series were of the marine Devonshire type.

The practical importance of this discovery at Ware thus seems to lie mainly in the knowledge thereby gained of the direction towards which any search for coal is most unlikely to be successful, for it is now seen that it would be useless to search for coal (in the London Basin) north of London. It would also appear that any search for water-bearing strata below the Gault south of Ware, as far at least as the River Thames, would be equally futile, Palæozoic strata here taking the place of the permeable beds of the Lower Greensand and the underlying clays. The geological interest of the discovery seems to be the knowledge of the old land-surface thus obtained. A Silurian ridge is now revealed to us, on the southern flanks of which repose Devonian rocks; against this old ridge on either side beat the waves of the Cretaceous or pre-Cretaceous seas; across the northern portion of our present metropolis the old coast-line of the southern sea is seen; near our county town the old coast-line of

the northern sea is just now brought to view;* and in the pebbles and sands which formed the shores of these two seas, or of the single ocean which may have been only partially divided by the old Palæozoic ridge, we are now endeavouring to obtain a supply of the purest fresh water existing within the limits of our London Basin.

APPENDIX.

I must now append a brief notice of two papers on the results of the boring at Ware which have been published since this paper was read before the Society. In the 'Popular Science Review' for July, 1879, will be found a paper, by Mr. Etheridge, on "The Position of the Silurian, Devonian, and Carboniferous Rocks in the London Area," giving much valuable information, and forming in fact a most exhaustive résumé of our knowledge of the subject. The paper is illustrated with a map and sections. It announces, for the first time, the discovery of rocks of undoubted Devonian age at the New River Company's boring at Turnford, near Cheshunt (in Hertfordshire), underlying the Gault, and containing the same species of fossils as were found at the Tottenham Court Road boring, such as *Spirifera disjuncta*, *Pterinea*, and *Rhynchonella*.

Mr. Etheridge gives the following list of fossils from the Wenlock rocks at the boring near Ware, all of which were obtained from a core less than three feet in length and one foot in diameter:—

PROTOZOA.—*Ischadites Kœnigi*, Murch.

ECHINODERMATA.—*Taxocrinus*, sp.; *Periechocrinus moniliformis*, Mill.

ANNELIDA.—*Tentaculites ornatus*, Sby.

CRUSTACEA.—*Phacops caudatus*, Brunn.

MOLLUSCA.—BRACHIOPODA.—*Orthis canaliculata*, Dalm.; *O. elegantula*, Dalm.; *Meristella tumida*, Dalm.; *Cyrtia exprorecta*, Wahl.; *Spirifera elevata*, Dalm.; *S. plicatella*, Linn.; *Athyris*, sp.; *Crania implicata*, Sby.; *Rhynchonella cuneata*, Dalm. (?); *Atrypa reticularis*, Linn.; *Pentamerus galeatus*, Dalm.; *P. linguifer*, Sby.; *Strophomena euglypha*, Dalm.; *S. reticulata*, McCoy; *S. depressa*, Dalm.; *S. rhomboidalis*, Wahl.; *S. antiquata*, Sby.; *Chonetes*, sp.; *Leptaena sericea*, Sby.; *L. transversalis*, Dalm. CONCHIFERA.—*Pterinea*, sp.; *Mytilus mytilimeris*, Conr.; *Ctenodonta*, sp.; *Orthonota rigida*, Sby. GASTEROPODA.—*Euomphalus rugosus*, Sby. CEPHALOPODA.—*Orthoceras attenuatum*, Sby.; *O. angulatum*, Wahl.

* The shore-line of that part of the Lower Greensand sea to the south of London must have run somewhere between Oxford Street and Kentish Town (Prestwich, *loc. cit.* p. 909), for the Lower Greensand, which attains a thickness of over 800 feet in the Isle of Wight, and from 400 to 700 feet in Kent and Surrey, indicating a deep sea basin, thins out to 64 feet at the corner of Oxford Street and Tottenham Court Road, where it has every appearance of a shore deposit, and is entirely absent at Kentish Town, where the old rocks most probably rose above the level of the sea. Again, in Buckinghamshire and Bedfordshire the Lower Greensand has a thickness of 200 to 300 feet (as near Hertfordshire as Arlesey, a few miles north of Hitchin, of at least 133 feet), and at Hitchin of at least 23 feet, while at Ware it has thinned out to a few inches, indicating by its conglomeratic nature, and its derived and worn fossils, a shore-line of the Lower Greensand sea to the north, probably communicating in a westerly direction, through Oxfordshire, with the southern sea. There is some indication of the depth of this sea in the fact that the Netherfield boring, near Battle, in Sussex, was carried to about twice the depth of the borings in London without the Palæozoic land-surface having been reached.

The second paper to which reference must be made is one by Mr. Godwin-Austen, "On some further Evidence as to the Range of the Palæozoic Rocks beneath the South-east of England," read before the Geological Section of the British Association at the Sheffield meeting, 1879, and printed *in extenso* in the 'Report' of that meeting (p. 227). In it Mr. Godwin-Austen quotes at some length from a communication on the results of the boring at Messrs. Menx's made by M. Dewalque to the Belgian Geological Society in 1878, in which he stated that he thought the most probable supposition was that the dip of the Upper Devonian beds was to the south, and that therefore the coal formation might occur at a short distance south of London and at a workable depth; and possibly, if the beds belonged to the extension of the southern basin of Belgium, on the north as well as on the south, in which case such a coal-basin might be as useless as the Belgian basin referred to. In answer to some observations M. Dewalque also added: "Starting from the supposition that our (Belgian) old strata are prolonged westward into England, and from the fact that Upper Devonian strata occur under London, we are led to admit that the band of Silurian slates of the Ostende boring must pass north of London."

Mr. Godwin-Austen then shows that this supposition has by the boring at Ware been proved to be correct, the succession of the Palæozoic strata on the English side of the Channel, even into the far west, being just what it is in Belgium and the north of France; and he then proceeds, from that and other considerations, to draw the inference that the lower members of the true Coal-measure formation may be expected to occur at about a quarter of a mile to the south of the corner of Tottenham Court Road and Oxford Street, and the upper or productive Coal-measures still farther to the south.

Accompanying the paper is a "Map to illustrate the evidence in support of the continuity of productive Coal-measures beneath the S.E. Counties of England."

These deep well-borings in the neighbourhood of London are thus contributing towards the solution of two problems of great economic importance,—the existence or otherwise in the south-east of England of productive Coal-measures at a workable depth; and the position of the Lower Greensand or of other permeable beds sufficiently deep-seated and extensive to furnish the metropolis with a large and never-failing supply of pure water.

33.—MISCELLANEOUS NOTES AND OBSERVATIONS.

[Read 12th June, 1879.]

GEOLOGY.

On a Boulder now in the Garden of the Royston Institute.—There is no evidence to show the exact locality from which the boulder now in the garden of the Royston Institute was obtained when first utilised by man, but there seems no doubt that it has formed the footstone of a cross from very early times. An extract from a diary extending from 1786 to 1811 is as follows:—"1786, June 3. Roy-stone, Royston, was removed from the Cross to the Market Hill, by order of G. Wortham, surveyor."

The stone was moved on the 28th April, 1856, to its present position on a low brick pedestal in the garden of the Royston Institute. In connexion with the establishment of the Institute an exhibition was held in that building in May, 1856, and amongst the objects exhibited was this "Footstone of the old Royston Cross," with the following particulars:—"This is the most venerable monument in the place. Its age cannot be exactly ascertained, but not improbably it belonged to Saxon times. It certainly existed before Royston was a town, and was a guide or direction to travellers over the open heath. It formerly stood on the spot still called The Cross, which was the point of junction of the two Roman military roads, the Ermen Street, and the Ieknield Way." The compiler of this catalogue was certainly correct in calling this stone the most venerable monument in the place, although he probably assumed for it no very great antiquity as compared with that of the age of ice, to which the geologist looks back. To the geologist the stone is but a mark of the glacial period. Its dimensions are 4ft. 8in., by 3ft. 6in., by 2ft. 2in. It is of irregular shape, well worn, and the angles rounded off. On its upper face is a hole, in which the upright portion of the cross was probably fixed. The material is Millstone-grit, of which many of the boulders found in this neighbourhood are composed. We may assume that the boulder was deposited in the immediate neighbourhood of its present position by ice, as it is improbable that the founders of the cross would have moved it any great distance.

Although boulders are fairly common in the neighbouring villages, there are none that equal this in size; one in Ashwell of a similar material is 3ft., by 2ft. 6in., by 1ft. 6in., and another at Bygrave, of fine yellowish compact sandstone, is 3ft., by 2ft., by 2ft., and now lies 300 feet above sea-level. The Royston boulder may therefore claim to be unique, both as regards size and historical importance, as far as the district in which it stands is concerned.—II. *George Fordham, Odsey.*

The Oxhey Cutting on the London and North-Western Railway, Watford.—The section I have now the pleasure of presenting to the Society was given to me by Mr. Buck, one of the engineers under Robert Stephenson. It may be easily compared with the cutting, which is well described as the Oxhey Cutting. Beginning with the London Clay, the next bed in descending order is a bed of silt in which sharks' teeth, etc., are found.* Its presence is worth notice, for as far as I can judge it was by striking this bed that the difficulties in the construction of the Thames Tunnel arose. The beds below are the plastic clays of the Woolwich and Reading series. The slips in the cutting show, I think, nearly all the beds.—[Rev.] *J. C. Clutterbuck, Long Wittenham Rectory, Abingdon.*

METEOROLOGY.

The Temperature of Thirty Summers and Thirty Winters at Hitchin.—The results given in the accompanying tables (p. 251) were obtained from thermometers the position of which was approved by Mr. Symons when on a visit here to inspect the effects of a hurricane at Baldock some few summers since. I undertook the analysis to disprove an idea that was current that after such a severe winter as we have just had we might expect a very hot summer, but unfortunately the present appalling weather, had I waited, would have saved me all the trouble. An old farmer in this neighbourhood has to go back to 1816 for a parallel case. There had been two successive very hard winters, and after the second, harvest was not begun until the middle of September, and may be said never to have been finished at all. The tables show that a hot summer has hardly ever followed a winter below the average.—*William Lucas, Hitchin.*

BOTANY.

Botanical Notes.—I noticed last autumn two curious sports. One was in a yellow dahlia in the rectory garden. On the same stem and branch there was a perfect purple flower, one other bloom had a few purple petals, but the rest were entirely yellow. The other sport occurred in fruit. A friend sent me a bunch of grapes in which the terminal berries had coalesced and formed one large fruit, the size of a tomato, and resembling one in form, with the seam and the swollen appearance of that fruit.

Last spring I cut some sprigs in flower from a male aucuba and placed them amongst some female plants. These are now full of berries and are just beginning to change from green to scarlet, assuming a pink tint soon to deepen into scarlet. I do not remember any other shrub that takes twelve months to ripen its fruit. The fruit of the ivy is now ripening, but it flowers in the

* The lowest zone of the basement-bed of the London Clay. The section is deposited in the Society's Library.—ED.

THIRTY WINTERS.

	Nov.	Dec.	Jan.	Feb.	Mar.	April.	Mean.	Min.
1849-50	41.5	37.0	32.3	42.3	38.1	47.8	39.8	19
1850-51	44.0	38.8	40.5	38.2	40.8	44.5	41.1	18
1851-52	35.0	37.5	38.5	38.0	38.5	43.0	38.4	21
1852-53	45.3	45.0	40.0	32.1	38.5	43.1	40.7	19
1853-54	40.6	32.6	33.9	35.1	38.0	43.0	37.2	10
1854-55	38.9	38.9	34.0	27.0	38.0	44.5	36.9	9
1855-56	39.2	33.6	37.0	40.3	37.5	45.5	38.9	0
1856-57	38.8	38.2	33.6	37.7	41.1	44.3	39.0	12
1857-58	43.7	42.3	35.5	34.0	40.1	44.8	40.1	14
1858-59	36.5	37.1	37.2	39.0	44.0	44.1	39.6	10
1859-60	38.9	34.5	36.5	32.6	39.7	41.3	37.2	13
1860-61	38.5	32.2	31.3	39.0	41.3	43.0	37.6	2
1861-62	37.7	36.7	36.5	39.0	41.7	46.8	39.7	10
1862-63	35.8	40.4	38.2	39.6	41.2	47.0	40.4	17
1863-64	42.7	39.9	33.7	34.4	39.4	47.0	39.5	23
1864-65	39.4	35.7	33.6	34.3	35.0	50.4	38.1	13
1865-66	42.1	40.6	41.0	39.5	40.6	47.7	41.9	14
1866-67	42.1	40.9	32.7	42.5	36.0	48.1	40.4	17
1867-68	39.6	35.0	35.8	41.5	42.1	47.0	40.2	9
1868-69	39.2	44.1	40.8	45.1	38.1	50.7	43.0	21
1869-70	42.5	37.5	37.4	34.5	38.3	47.0	39.5	22
1870-71	39.3	30.9	31.3	41.0	43.1	47.3	38.8	9
1871-72	35.0	36.0	38.5	42.3	43.0	46.0	40.1	15
1872-73	42.1	39.0	38.3	32.9	39.3	44.2	39.3	25
1873-74	40.3	37.2	38.2	35.6	40.8	47.7	39.9	20
1874-75	38.5	29.2	40.0	32.1	37.8	43.7	36.9	13
1875-76	38.5	35.5	33.0	38.1	37.7	44.0	37.8	19
1876-77	39.9	39.6	37.9	39.2	37.1	42.9	39.3	15
1877-78	40.5	36.3	37.5	40.0	39.9	46.5	40.1	20
1878-79	36.9	31.0	28.9	36.0	39.1	41.1	35.5	15
Mean	39.8	37.1	36.1	37.4	39.5	45.5	39.2	

THIRTY SUMMERS.

	May	June	July	Aug.	Sept.	Oct.	Mean.	Max.
1849	50.6	56.7	59.1	60.0	56.3	48.0	55.1	78
1850	49.9	58.5	61.0	61.0	54.4	46.2	55.2	80
1851	50.3	57.7	58.2	60.5	54.1	50.7	55.2	80
1852	49.6	56.3	64.3	60.3	55.1	45.4	55.2	84
1853	51.0	57.3	60.3	59.0	54.7	49.5	55.3	75
1854	50.6	58.1	60.0	59.2	56.0	47.5	55.2	81
1855	47.3	55.3	61.0	59.3	53.3	49.0	54.2	80
1856	49.2	57.7	60.1	61.0	53.5	50.0	55.3	80
1857	51.5	59.5	62.3	62.7	57.5	51.2	57.4	83
1858	50.3	62.5	58.0	59.5	58.0	49.0	56.2	86
1859	50.0	62.0	65.3	60.5	55.0	49.0	57.2	83
1860	52.5	54.5	57.2	56.7	51.0	48.5	53.4	72
1861	50.6	58.5	61.0	61.0	55.0	52.2	56.2	80
1862	54.9	55.5	57.0	56.0	55.0	49.5	54.6	73
1863	50.7	57.1	59.0	61.0	52.0	49.0	54.6	78
1864	52.9	57.5	60.3	57.4	55.5	48.2	55.3	80
1865	54.5	59.0	62.1	59.4	60.5	47.8	57.2	79
1866	49.6	60.5	59.0	58.5	55.0	49.7	55.4	78
1867	51.9	56.9	58.0	60.5	55.9	47.7	55.1	80
1868	55.5	60.5	64.8	61.9	56.7	45.9	57.5	88
1869	50.5	55.9	63.2	59.1	58.5	49.0	56.0	85
1870	52.0	60.1	63.5	59.0	53.2	47.6	55.9	81
1871	50.5	54.9	60.0	62.1	55.5	47.8	55.1	82
1872	49.5	58.0	63.3	57.8	55.6	45.3	54.9	82
1873	48.8	57.5	61.0	60.5	50.9	45.0	54.0	79
1874	47.9	55.5	61.9	57.8	54.5	48.5	54.3	83
1875	51.4	56.8	55.9	59.3	56.5	45.9	54.3	77
1876	46.1	56.8	61.8	59.1	52.5	49.0	54.2	81
1877	45.9	57.6	57.8	58.1	49.1	44.5	52.2	75
1878	52.8	58.0	60.0	60.9	54.2	47.3	55.6	80
Mean	50.6	57.7	60.5	59.6	54.8	48.1	55.2	

autumn, and the arbutus, which fruits well with me, has both flowers and fruit on it at the same time, which I think is also the case with the laurustinus.

I have (or had) two flourishing plants of the *Eucalyptus globulosa*, three years old, and twenty feet high, but I think this severe winter has killed them. The stems at present look sound, but I observe that the bark at the root, just above the ground, is separating from the stem, and is loose and flaccid. The 'Kew Guide,' and Professor Bentley's lecture printed in the 'Pharmaceutical Journal' for May, 1878, supply much valuable information on this tree.—[Rev.] R. H. Webb, *Essendon Rectory, Hatfield*.

MICROSCOPY.

The Micro-megascpe.—I am anxious to introduce to the members of this Society a contrivance, which was recently shown by Dr. Matthews at a meeting of the Quekett Microscopical Club, for converting an ordinary microscope into what Dr. Matthews calls a "Micro-megascpe," for the reason that it is possible to magnify or diminish the object under examination at will by decreasing or diminishing its distance. Some similar arrangement had been used before, but Dr. Matthews worked it out independently and made one great improvement, an all-important improvement, on what had previously been done.

The arrangement consists in placing a low power objective—I find a 3-inch is best—in an adapter in the sub-stage. It must be placed with its front combination *upwards*, that is, towards the body of the microscope. It is this reversed position of the lower object-glass that is the great point of Dr. Matthews' discovery. Another object-glass—2-inch or 1-inch, or a higher power—is placed in the ordinary way on the nose of the microscope body. It is necessary to remove the mirror, and to place the object on the table below the lower objective. The lower objective forms an aerial image, which is then magnified by the upper object-glass.

This arrangement really converts the microscope into a low power terrestrial telescope, for the object may be placed any distance away, but the nearer it is brought to the lower object-glass, the more it is magnified.

The arrangement has great advantages—the object is seen erect instead of being inverted as usual in the microscope—the definition is perfect, and the field wonderfully flat, so that it is easy to draw very convex objects with the camera lucida.

Dr. Matthews' paper upon the subject in the 'Journal of the Quekett Microscopical Club,' vol. v, p. 167, explains other methods of working with it, and is well worthy of study.—*Arthur Cottam, Watford*.

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ERRATA.

Page xxxii, after last line *add*, "6. Notes on Birds observed in 1878. By John E. Littleboy. (*I*de p. 143.)"

„ xxxv, line 29, *for* "iv" *read* "xiv."

„ lii, line 3, *for* "hatched" *read* "disturbed."

„ liii, line 12 from bottom, *for* "annual" *read* "animal."

„ 98, line 31, *for* " $10\frac{1}{2}$ " *read* " $20\frac{1}{2}$."

„ 225, line 18 (of figures in table), Datchworth, March, *for* "2.38" *read* "1.00," April, *for* "1.00" *read* "2.38."

„ 225, last line, March, *for* "1.09" *read* "1.04," April, *for* "3.12" *read* "3.17."

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Page vi, last line, *for* "1878" *read* "1877."

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- BAYNE, REV. R. Rickmansworth and its Neighbourhood. 8vo. London and Aylesbury, 1870.
- BOTANY, JOURNAL OF. New Series. Vols. vii-viii. 8vo. London, 1878-79.
- BOWERBANK, J. SCOTT. History of the Fossil Fruits and Seeds of the London Clay. 8vo. London, 1840.
- BRADY, DR. G. S. A Monograph of the Free and Semi-parasitic Copepoda of the British Islands. Vol. i. (*Ray Society.*) 8vo. London, 1878.
- BRIGHTON AND SUSSEX NATURAL HISTORY SOCIETY. Proceedings for 1874-75 to 1876-77. 8vo. Brighton, 1875-78.
- BUCKLAND, REV. DR. W. Geology and Mineralogy considered with reference to Natural Theology. New Edition, edited by Frank T. Buckland. 2 vols. 8vo. London, 1858.
- BUCKLAND, FRANK T. Fish-Hatching. 8vo. London, 1863.
- BUCKTON, G. B. Monograph of the British Aphides. Vol. ii. (*Ray Society.*) 8vo. London, 1879.
- BUTT, REV. J. M. Introduction to English Botany. 8vo. London, 1825.
- CARDIFF NATURALISTS' SOCIETY. Transactions for 1874-76. 8vo. Cardiff, 1875-77.
- CORNWALL, ROYAL, POLYTECHNIC SOCIETY. Reports for 1875-77. 8vo. Falmouth and Truro, 1876-78.
- BRISTOL NATURALISTS' SOCIETY. Proceedings. New Series. Vol. ii. 8vo. Bristol, 1879.
- DALLAS, W. S. Elements of Entomology. 8vo. London, 1857.
- DAVY, DR. JOHN. Physiological Researches. 8vo. London, 1863.
- DREW, DR. JOHN. Practical Meteorology. 8vo. London, 1855.
- ENTOMOLOGIST. Vols. xi-xii. 8vo. London, 1878-79.

- FORSTER, T. *Pocket Encyclopædia of Natural Phenomena.* 12mo. London, 1827.
- FRANCIS, A. J. *A Brief Survey of Physical and Fossil Geology.* 8vo. London, 1839.
- GEIKIE, JAMES. *The Great Ice Age and its Relation to the Antiquity of Man.* 8vo. London, 1874.
- GEOGRAPHICAL MAGAZINE. Vols. i and v. 4to. London, 1874 and 1879.
- GEOLOGICAL SOCIETY. *Abstracts of the Proceedings for 1874-75 to 1877-78.* 8vo. London, 1874-78.
- GEOLOGISTS' ASSOCIATION. *Proceedings.* Vol. v. 8vo. London, 1878.
- GLASGOW NATURAL HISTORY SOCIETY. *Proceedings.* Vol. iii. 8vo. Glasgow, 1878.
- GLASGOW, PHILOSOPHICAL SOCIETY OF. *Proceedings.* Vol. xi. 8vo. Glasgow, 1879.
- GOSSE, PHILIP HENRY. *An Introduction to Zoology.* 2 vols. 8vo. London, 1844.
- GREVILLEA, A QUARTERLY JOURNAL OF CRYPTOGAMIC BOTANY. Vols. iii-vii. 8vo. London, 1875-79.
- GROVE, W. R. *The Correlation of Physical Forces.* 3rd Edition. 8vo. London, 1855.
- HAYDEN, PROF. F. V. *Sun-Pictures of Rocky Mountain Scenery.* 4to. New York, 1870.
- . *Geological and Geographical Atlas of Colorado. (U.S. Geol. Surv.)* Folio. Washington, 1877.
- HOGG, JABEZ. *The Microscope; its History, Construction, and Application.* 6th Edition. 8vo. London, 1867.
- IRELAND, ROYAL GEOLOGICAL SOCIETY OF. *Journal.* Vol. iv. 8vo. Dublin, 1877.
- JENYNS, REV. LEONARD. *Observations in Natural History.* 8vo. London, 1846.
- LOWRY, J. W. *Chart of Characteristic British Tertiary Fossils.* 8vo. London, n.d.
- MANCHESTER GEOLOGICAL SOCIETY. *Transactions.* Vol. xiv. 8vo. Manchester, 1878.
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- MAURY, LIEUT. F. M. The Physical Geography of the Sea.
2nd Edition. 8vo. London, 1855.
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- METEOROLOGICAL SOCIETY. Quarterly Journal. New Series. Vols.
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- NATURALIST. Vols. i-viii. 8vo. London, 1851-58.
- PAGE, DAVID. Handbook of Geological Terms, Geology, and
Physical Geography. 2nd Edition. 8vo. Edinburgh and
London, 1865.
- . Introductory Text-book of Geology. 8vo. Edinburgh
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- PHIPSON, DR. T. L. Phosphorescence. 2nd Edition. 8vo. London,
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Washington, 1878.
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Proceedings. New Series. Vols. iii-iv. 8vo. Taunton, 1878-79.

SYMONS, J. G. British Rainfall, 1864-74 and 78. 8vo. London, 1865-75 and 79.

———. Monthly Meteorological Magazine. Vol. xiii. 8vo. London, 1878.

TURTON, DR. W. A Manual of the Land and Fresh-water Shells of the British Islands. 8vo. London, 1831.

UNITED STATES GEOLOGICAL AND GEOGRAPHICAL SURVEY OF THE TERRITORIES. Bulletin. Vol. iv. 8vo. Washington, 1878.

UNITED STATES ENTOMOLOGICAL COMMISSION. Annual Report for 1877, relating to the Rocky Mountain Locust. (*U.S. Geol. Surv.*) 8vo. Washington, 1878.

WHARTON, H. T. A List of British Birds. 8vo. London, 1877.

WHITAKER, W. The Geology of the N.W. part of Essex, and the N.E. part of Herts; with parts of Cambridgeshire and Suffolk. (Sheet 47 of the Map of the Geological Survey.) 8vo. London, 1878.

YORKSHIRE GEOLOGICAL AND POLYTECHNIC SOCIETY. Proceedings. Vols. v-vi. 8vo. Leeds, 1870-77.

ZOOLOGIST. 3rd Series. Vols. ii-iii. 8vo. London, 1878-79.

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Contents :

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DREW, DR. JOHN. Remarks on the Climate of Southampton (*Rep. Brit. Assoc. for 1851.*)

ROYAL SOCIETY. Report of the Committee of Physics, including Meteorology, on the Objects of Scientific Inquiry in those Sciences. London, 1840.

PAMPHLETS. Vol. VI. Meteorology. 8vo.

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———. The 'Challenger's' Crucial Test of the Wind and Gravitation Theories of Ocean Circulation. (*ib.* 1875.)

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———. Further Remarks on the "Crucial-test" Argument. (*ib.*)

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———. ——— during the Half-year ending 31st August, 1877. (*ib.* 1879.)

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———. ——— in 1877. (*ib.* 1879.)

———. ——— in 1878. (*ib.* 1879.)

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———. Reduction of Meteorological Observations. (*ib.* 1879.)

- [PRESTON, REV. T. A. Meteorological Observations taken at Marlborough, 1865-72.] (*Rep. Marl. Col. Nat. Hist. Soc.* 1873.)
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———. The Origin and Present Distribution of the British Flora. (*ib.* 1879.)

———. The Student's Catalogue of British Plants. London, 1879.

LINDLEY, PROF. Descriptive Botany. 2nd Edition. London, 1860.

LITTLEBOY, J. E. A Few Words about our Local Ferns. (*Trans. Watford Nat. Hist. Soc.* 1876.)

[PRESTON, REV. T. A.] Botanical Notices [1870]. (*Rep. Marlborough College Nat. Hist. Soc.* 1870.)

PRYOR, R. A. Notes on a proposed re-issue of the Flora of Hertfordshire, with Supplementary Remarks on the Botany of the Watford District. (*ib.* 1875.)

———. On the Occurrence of *Medicago Lappacea*, Lamk., in Bedfordshire; with some additions to the recorded Flora of that County. (*Journ. of Botany*, 1876.)

———. On the Botanical Work of the Past Season. (*Trans. Watford Nat. Hist. Soc.* 1876.)

WATSON, H. C. The London Catalogue of British Plants. 7th Edition. London, 1874.

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Contents:

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———. Notes and Queries on the River Colne, Watford. (*ib.*)

COLLETT, ROBERT. Bird Life. [A translation.] (*Rep. Marlborough College Nat. Hist. Soc.* 1870.)

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HARTING, J. E. "The Field" Calendar of Ornithology, 187.

———. "The Field" Calendar of Ornithology. General Report for 1872. [London, 1873.]

———. On the Pleasures and Advantages to be derived from a Study of Natural History, and more particularly from the Observation of Birds. (*Trans. Watford Nat. Hist. Soc.* 1875.)

HOOD, DR. PETER. Notes on the May Fly. (*ib.* 1879.)

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———. Further Notes on Our Birds. (*ib.*)

———. Notes on Birds Observed in 1878. (*ib.* 1879.)

———. The Bulborne and Gade, with Notes on the Fish of the two Rivers. (*ib.*)

NEWTON, ALFRED. On a Method of registering Natural History Observations. (*Trans. Norfolk and Norwich Naturalists' Soc.* 1871.)

ORMEROD, ELEANOR A. Notes on Economic Entomology. (*ib.* 1878.)

———. Notes for Observations of Injurious Insects. (*ib.*)

———. The Prevention of Insect Injury by the Use of Phenol Preparations. (*Trans. Entomological Soc.* 1878.)

PEEL, REV. H. R. Bees and Bee-keeping. (*Trans. Watford Nat. Hist. Soc.* 1879.)

PERKINS, REV. C. M. On British Butterflies. (*ib.* 1878.)

TUKE, J. H. Notes on Birds Observed near Hitchin. (*ib.*)

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 PRYOR, R. A. On the supposed Chalybeate Spring at Watford, and on other Medicinal Waters in Herts. (*Trans. Watford Nat. Hist. Soc.* 1876.)
 WARD, J. CLIFTON. Literary and Scientific Education. Presidential Address delivered before the Keswick Literary and Scientific Society, on the opening of the Sixth Session, 1874-5. Cockermonth, 1874.

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